Basic Service Procedures and Principles of Operation for the KM 56 RC-E KombiMotor

Introduction

- The KM 56 RC-E is a 2-cycle stratified scavenge engine
- The stratified scavenge engine design is more fuel efficient using about 20% less fuel than previous models with similar displacement
- This engine design is very effective at reducing exhaust emissions

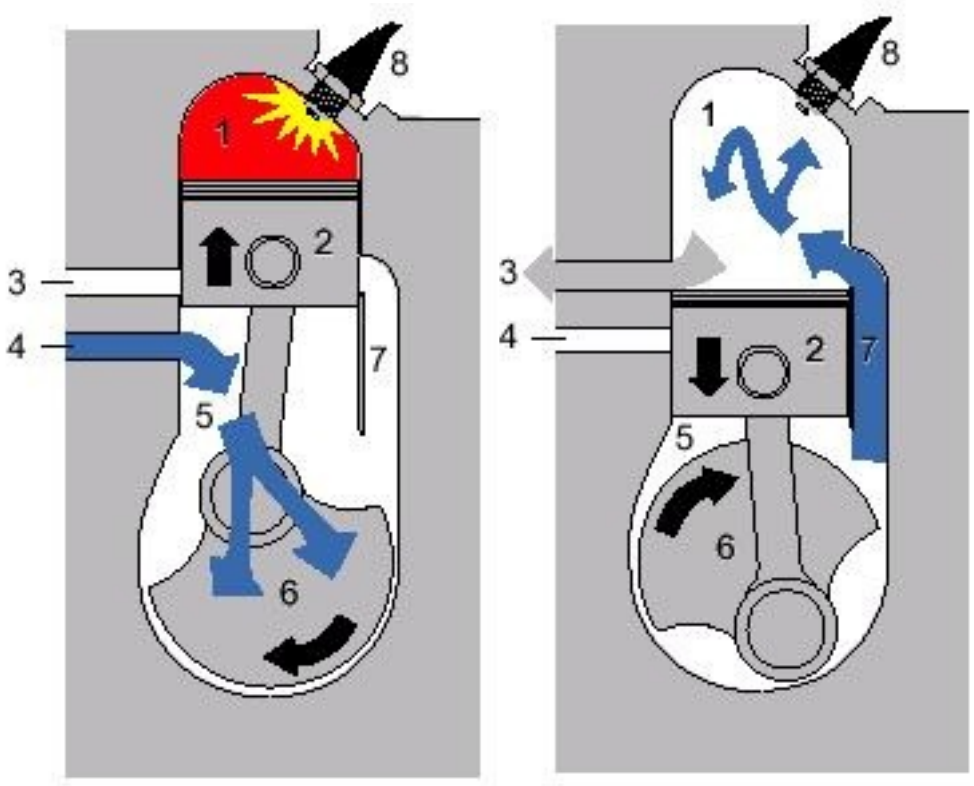
Specifications

Engine Displacement	27.2 cc	1.66 cu. In.
Engine Power	0.8 kW	1.1 bhp
Weight	4.3 kg	9.5 lbs.
Fuel Capacity	340 cc	11.5 oz.
Engine Idle Speed		2500 RPM
Maximum Engine Speed		10000 RPM

Two-Stroke Piston Port Engine Design

- A conventional two-stroke piston port engine operates by:
  - Piston moves up and creates vacuum in the crankcase which draws air-fuel-oil mix in from the carb
  - Piston skirt comes down and blocks the intake port and creates pressure in the crankcase
  - Piston continues down and pushes air-fuel-oil mix through the transfer ports and into the combustion chamber, which helps push the exhaust gases out the exhaust port
  - Piston comes up and compresses the air-fuel mix
  - Spark plug ignites the air-fuel mix and expanding gases push the piston down on the power stroke

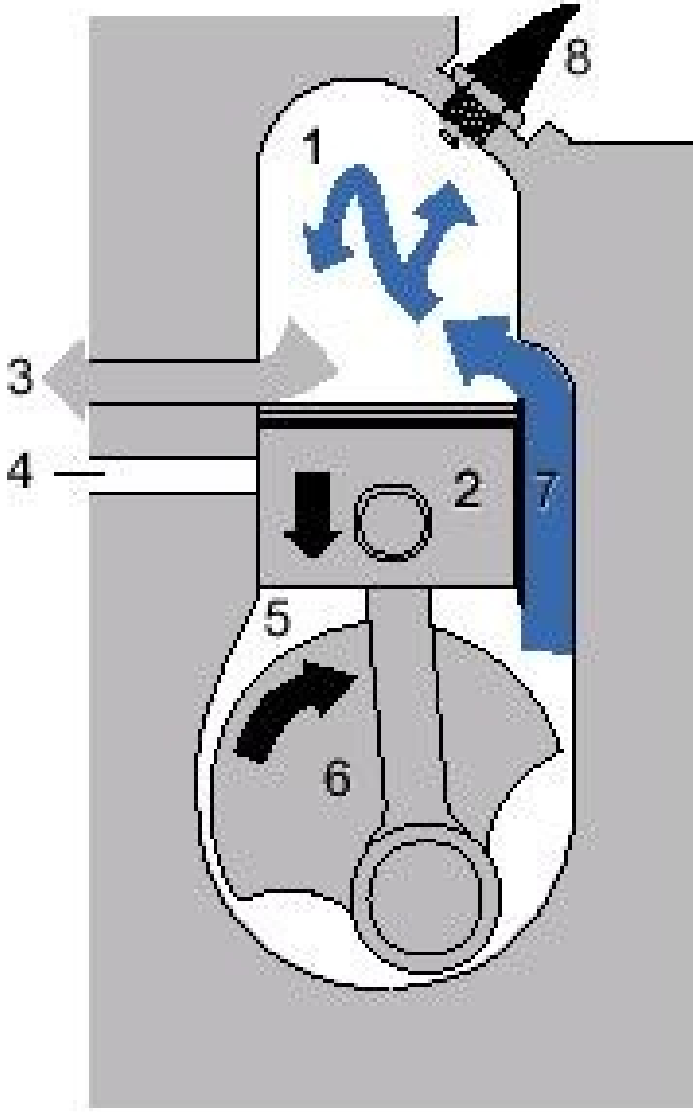
- 1 Combustion Chamber
- 2 Piston
- 3 Exhaust Port
- 4 Intake Port
- 5 Crankcase
- 6 Crankshaft
- 7 Transfer Port
- 8 Spark Plug



Two-Stroke Piston Port

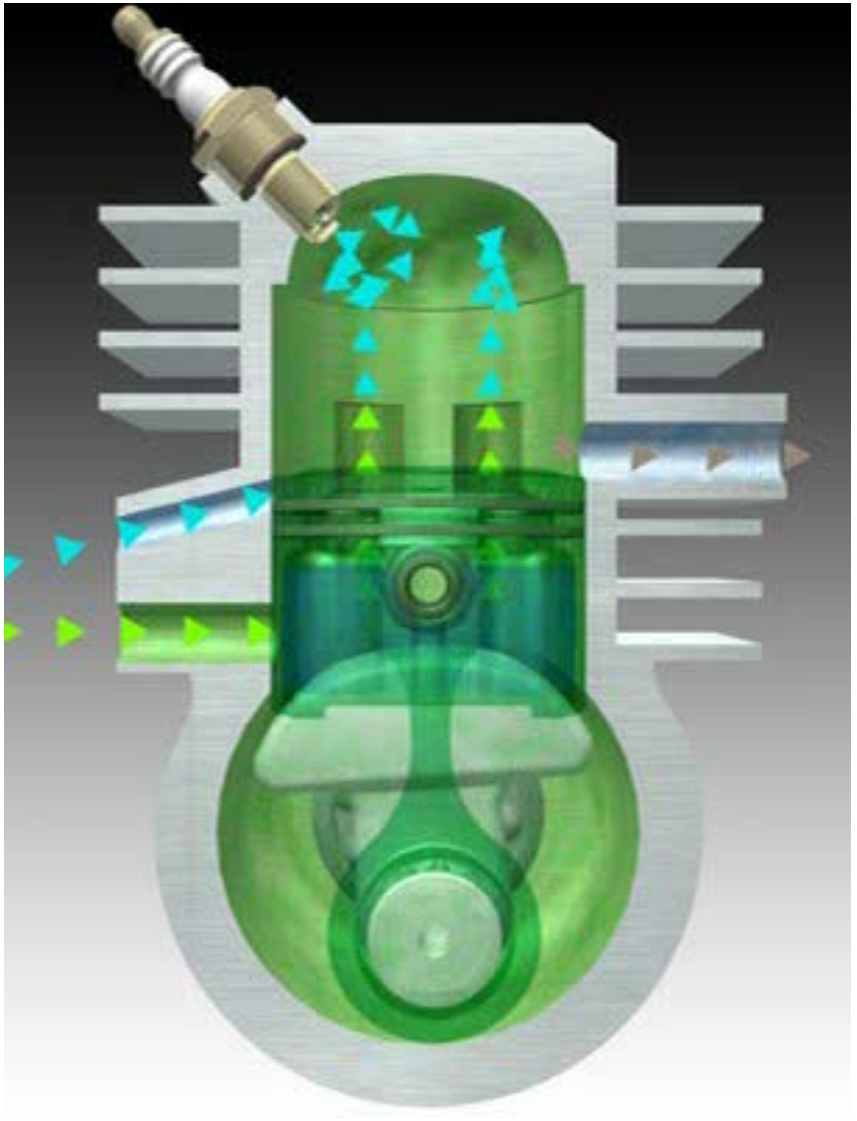
Scavenge Loss

- Notice that the blue incoming air-fuel mix sweeps through the combustion chamber and helps push the exhaust gases out through the open exhaust port
- It is the nature of a typical two-stroke piston port engine design that some of the air-fuel mix that transfers into the combustion chamber leaks out the open exhaust port
- This is called scavenge loss of unburned fuel and is the primary reason that two-stroke engines have poorer fuel economy and higher emissions than a four-stroke engine



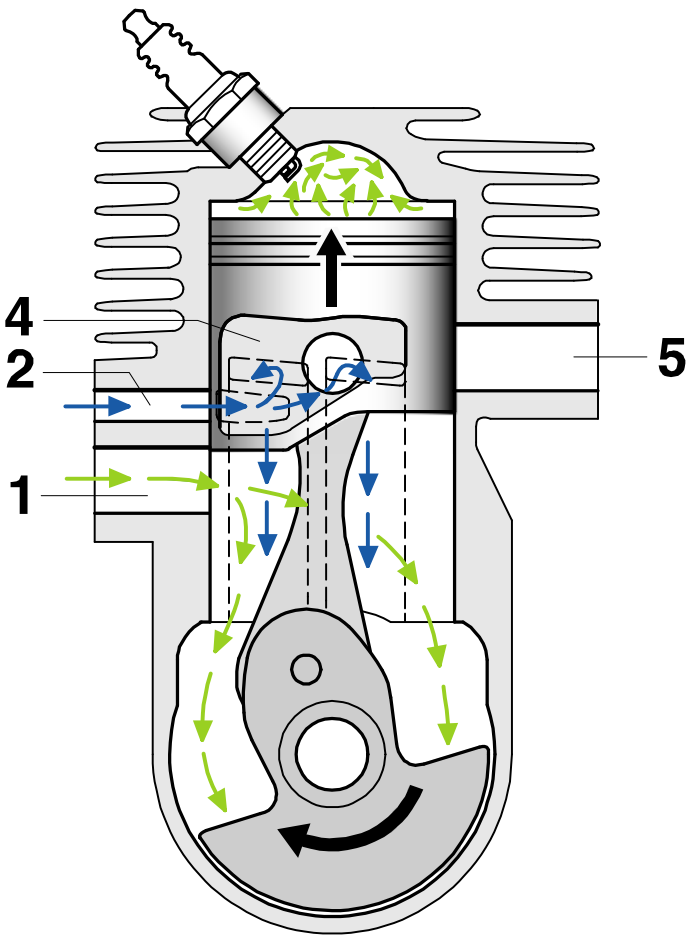
KM 56 RC-E Stratified Scavenge Engine Design

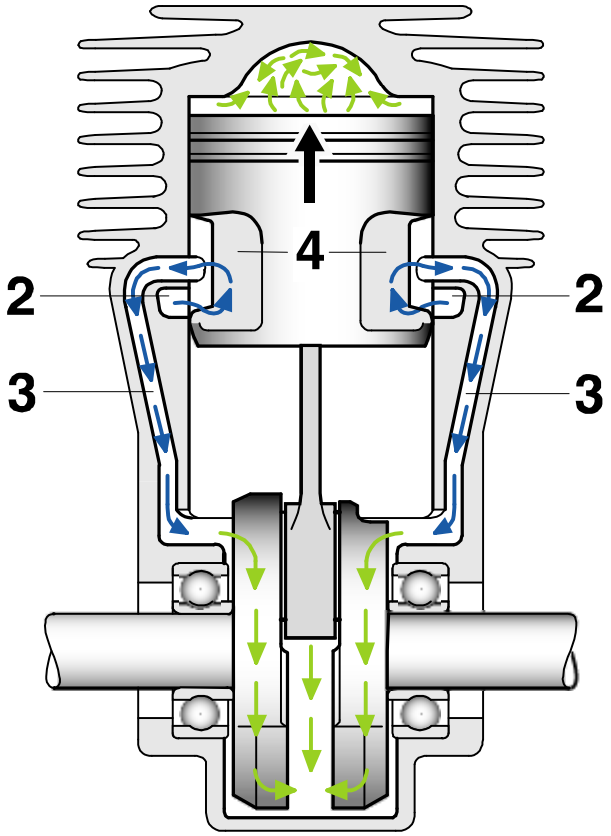
- A stratified scavenge two-stroke piston port engine operates by:
  - Introducing a puff of clean filtered air between the exhaust gases and the incoming air-fuel mix
  - The air is routed into the transfer ports from the top down and stacks up there until it is released into the combustion chamber
  - The small amount of air holds the air-fuel mix back for a fraction of a second to give the piston time to move up and close the exhaust port
  - This creates an increase in fuel economy and a decrease in unburned hydro-carbon emissions



Piston Ported Stratified Scavenging: Intake / Compression Stroke

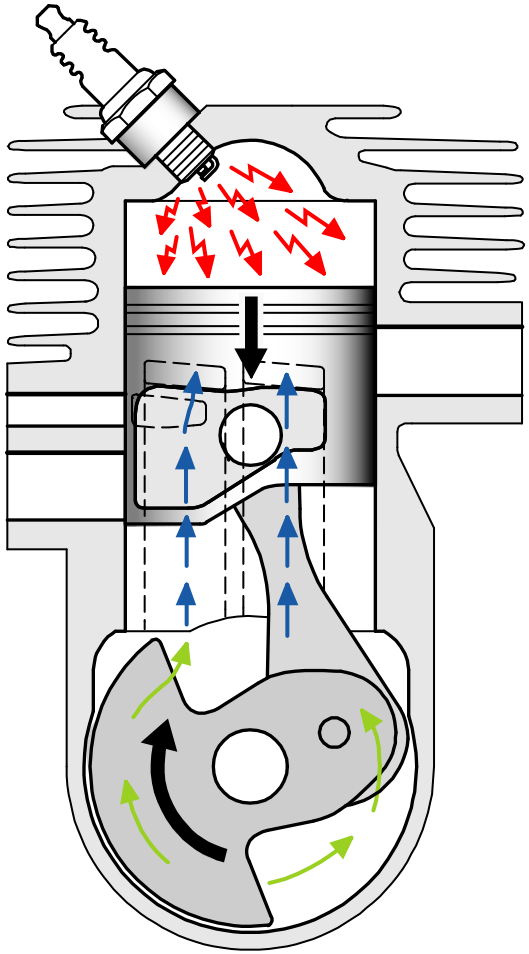
- Fresh air-fuel mix from the carb enters the low pressure in the crankcase through the intake port (1)
- Clean air enters through the bypass ports (2)
- The control recess (4) in the piston skirt routes the air into the top of the transfer ports (3)
- The air travels down the transfer ports (3) towards the crankcase

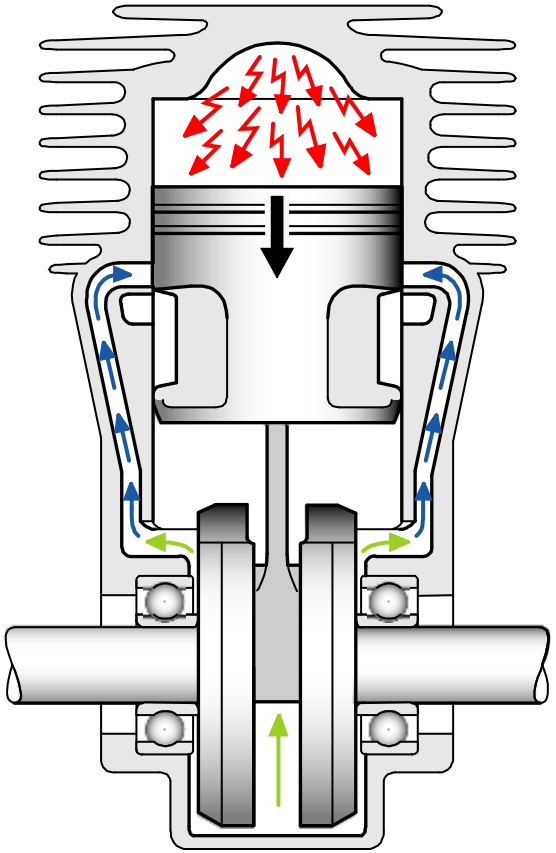




Piston Ported Stratified Scavenging: Power Stroke / Transfer Port Loading

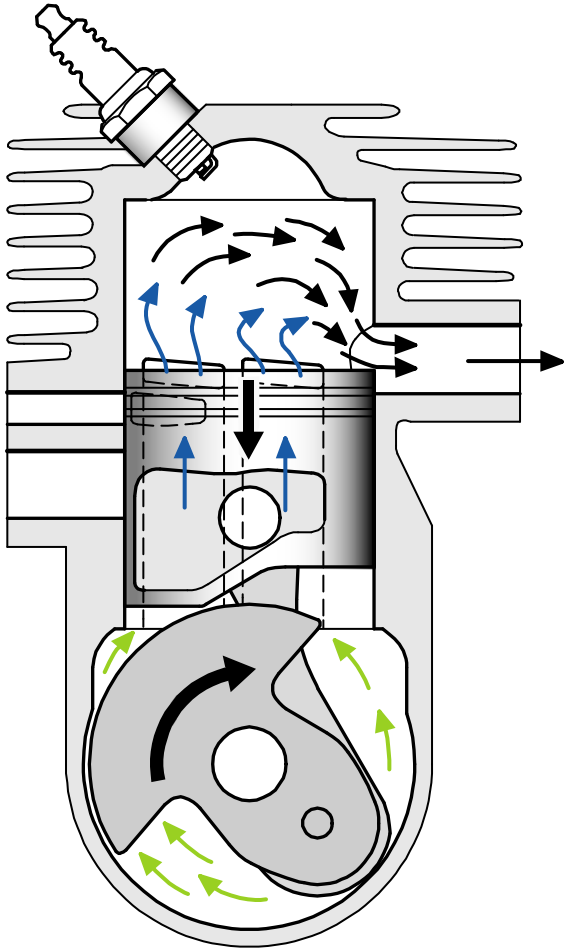
- As the piston moves down the fresh air is trapped in the transfer ports
- The piston is coming down on the power stroke
- The underside of the piston is pressurizing the air fuel mix in the crankcase

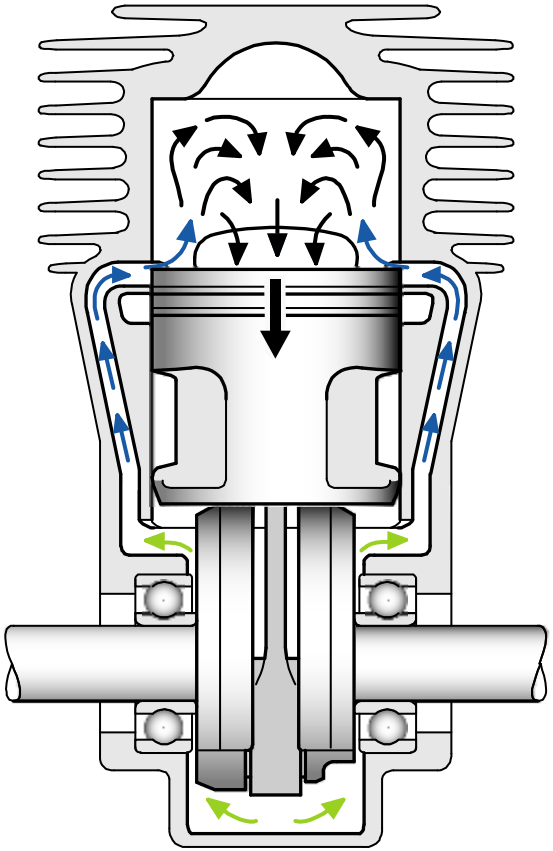




Piston Ported Stratified Scavenging: Scavenging / Exhaust Stroke

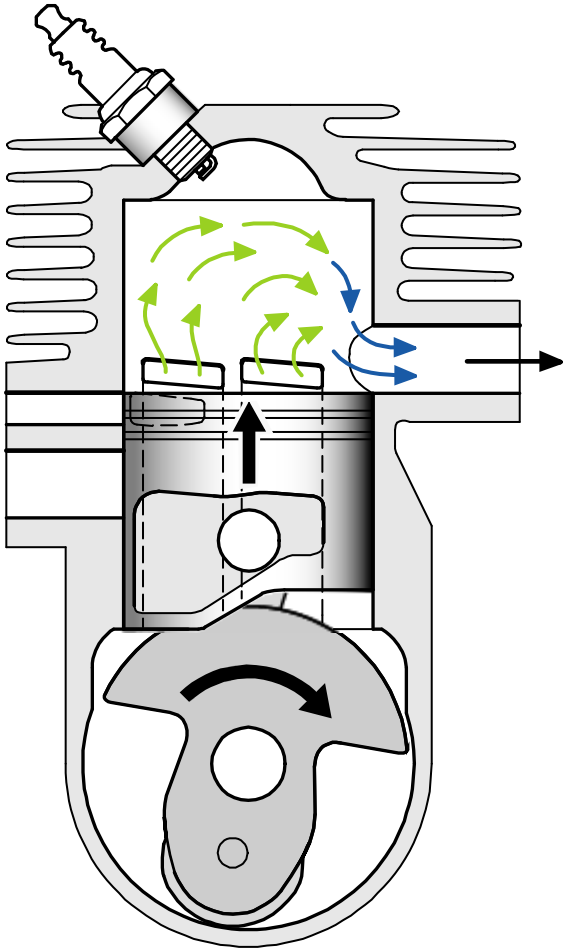
- As the piston opens the transfer ports the fresh air comes in first
- The air scavenges out the exhaust gases
- The air-fuel mix is delayed from entering the combustion chamber for a fraction of a second

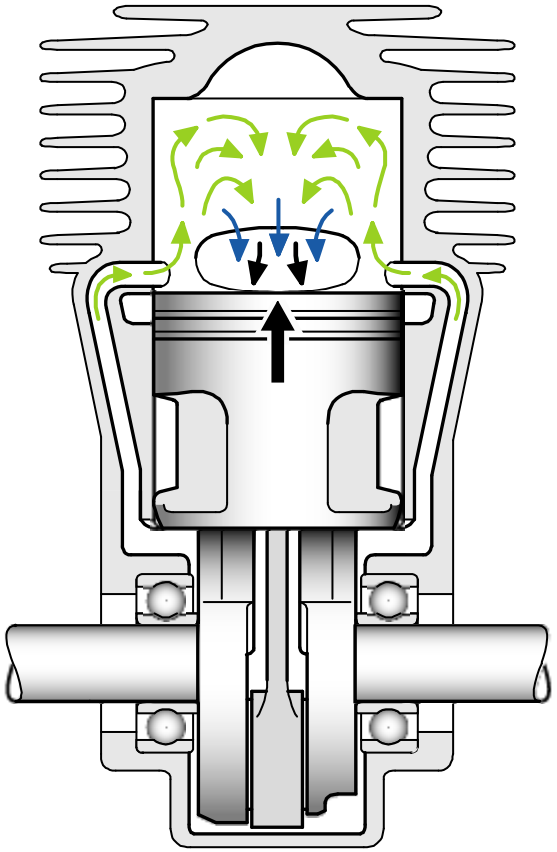




Piston Ported Stratified Scavenging: Transfer and Scavenging

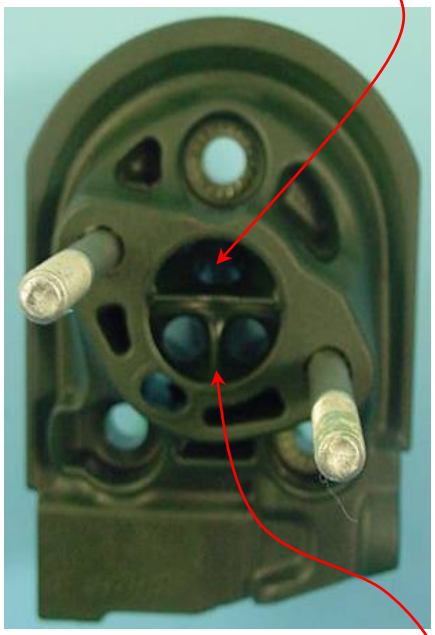
- The fresh air is now pushed by the air-fuel mix to continue the exhaust scavenging process
- The piston now comes back up and closes the exhaust port
- This minimizes the scavenge loss of unburned hydro-carbons out the open exhaust port





KM 56 RC-E Stratified Scavenge Design

Air-Fuel Mix From Carb Enters Flange Here



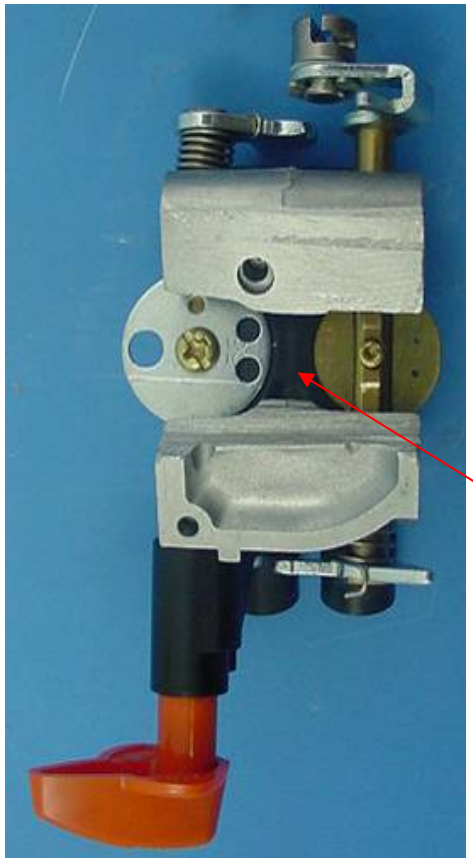
Scavenge Air From Carb Enters Flange Here

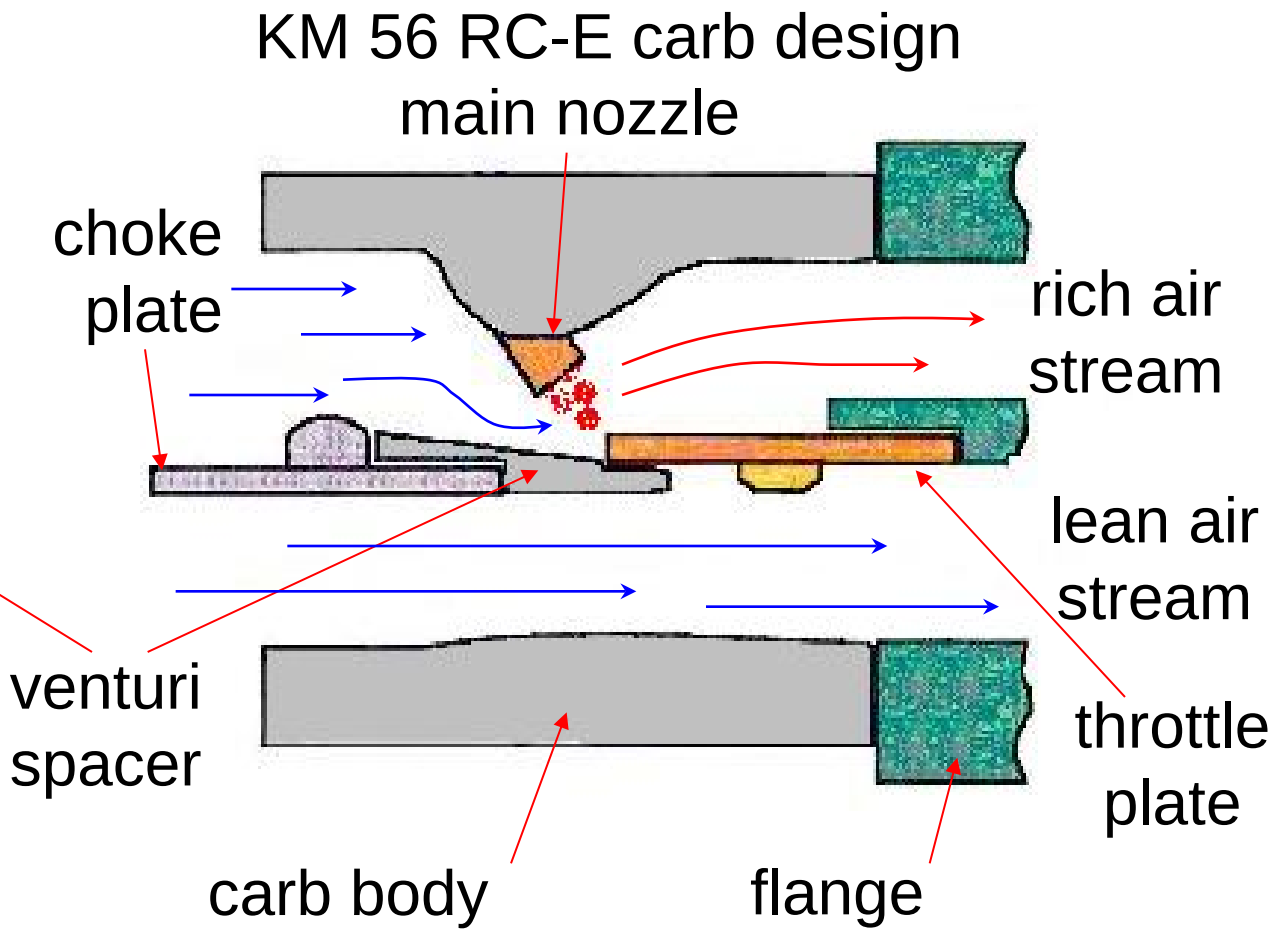
Scavenge Air From Carb Exits Flange Here

Air-Fuel Mix From Carb Exits Flange Here

Sleeved Cylinder with closed transfer ports

New Split Carb Design for Stratified Scavenging





KM 56 RC-E Operating Features

- Reading and becoming familiar with the instruction manual is the first step to learning about the blower, it's features and how to operate it safely

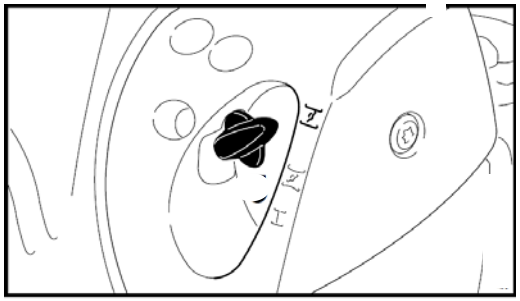
- Starting and general operation and maintenance is explained

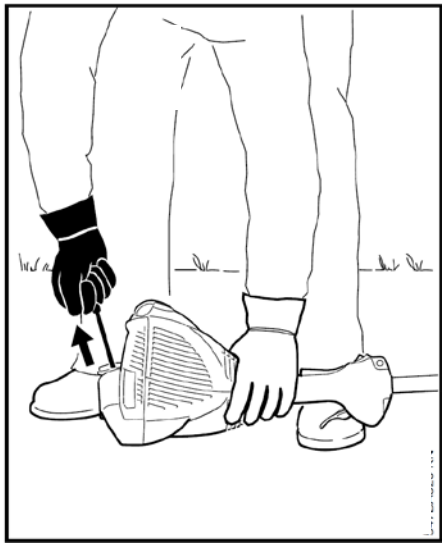
Function of the Stop Switch

- The stop switch has a spring loaded rocker style action, and is normally in the run position
- Rock the switch to the **O**, or off position to stop the engine
- The switch does not have to be held in the **O** position, just pushed down and released
- The ignition module resets itself automatically to the run position after the flywheel stops turning
- WARNING! When service work is performed always disconnect the spark plug terminal!
- Remove the spark plug terminal with a twisting motion

Starting the KM 56 RC-E

- Fill the tank with 89 octane brand name fuel with STIHL two-stroke oil mixed at a 50:1 ratio
- Pump the purge primer bulb until it fills with fuel, at least five times
- Push in the choke knob and rotate upward and it locks in the cold start position

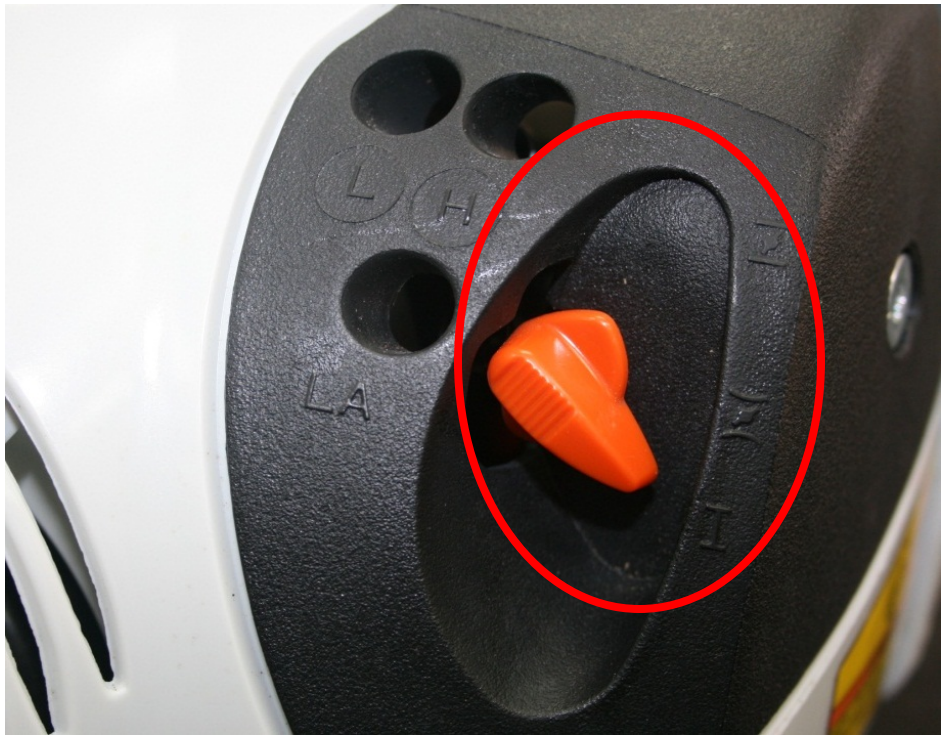




- Hold the unit against the ground with the right hand on the handle
- Pull the rope through until the engine starts, usually within one to two pulls

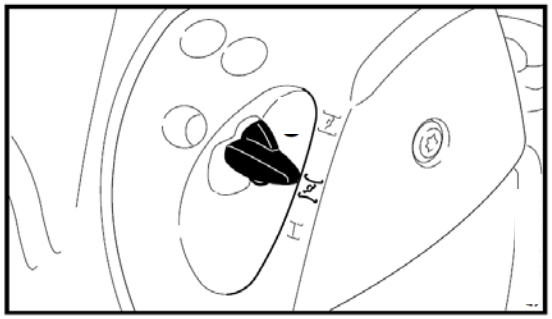
Starting the KM 56 RC-E

- Once the engine starts it will stay running but the choke is still in the ON position
- Activate the throttle trigger slightly and the choke will release automatically and the engine will drop down to idle
- The choke also locks in the middle, warm start postion
- The choke always releases automatically when the throttle trigger is activated
- Allow the engine to idle for at least 1/2 a minute to warm up
- A cold engine may not accelerate smoothly until it is warmed up

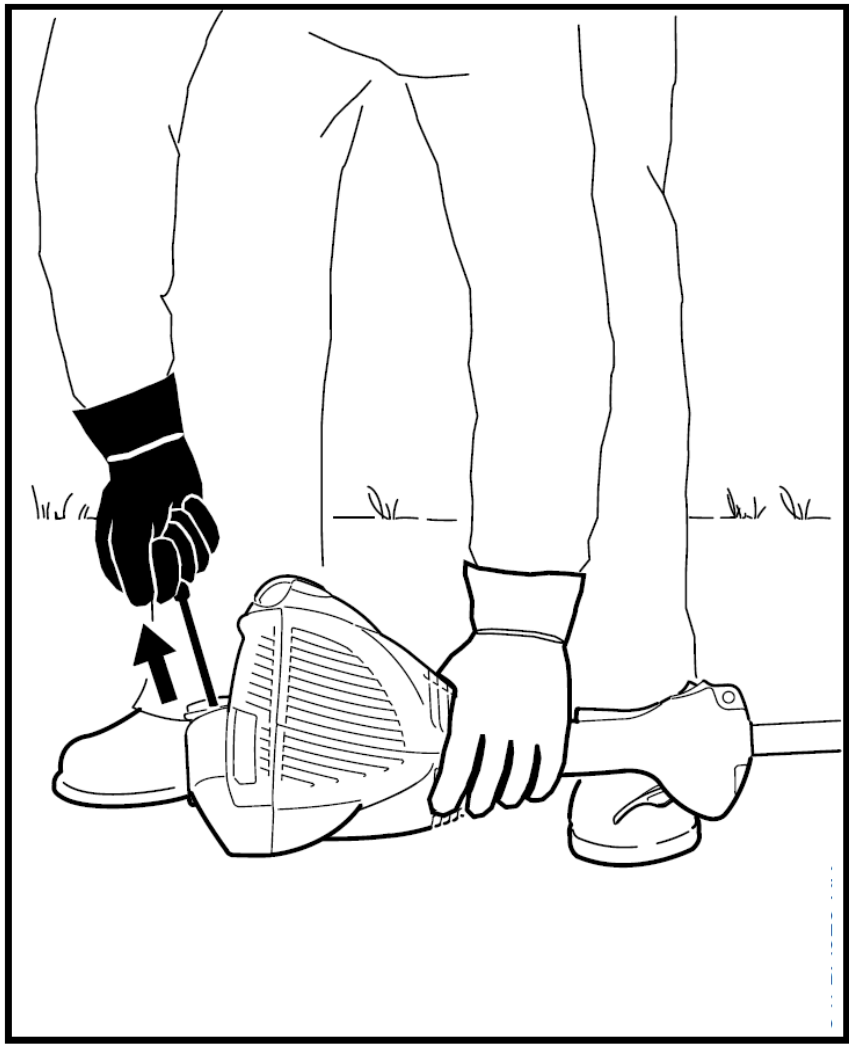


Warm Starting the KM 56 RC-E

- If the engine has been running and then is stopped for a short time, always set the choke control to the middle position

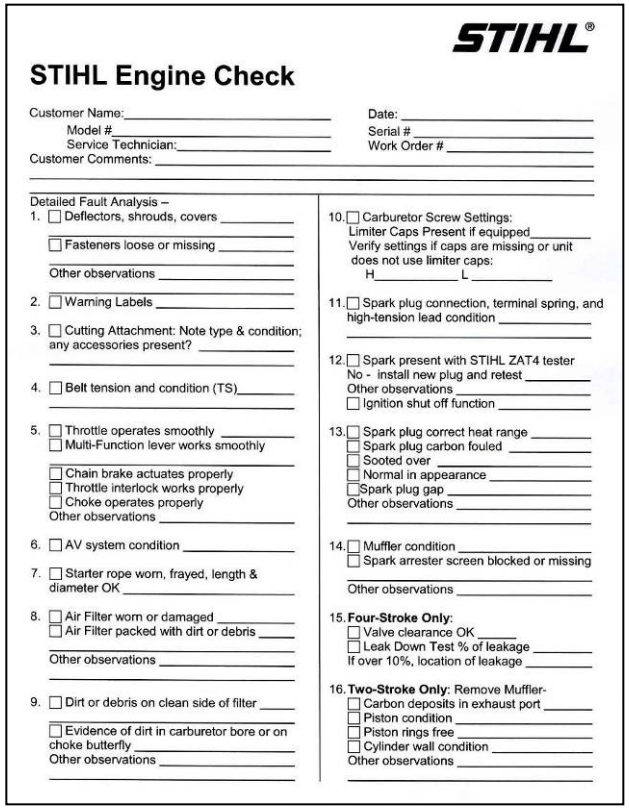


- The engine should start on the first pull, and will be at a fast idle
- Activate the throttle and the engine will return to idle



Fault Analysis: STIHL Engine Check

- When a unit is running poorly or not at all, using a systematic approach to identify any and all faults present will allow the Service Technician to quickly and efficiently determine what is wrong
- It is just as important to know what faults are not present as well as faults that do need to be addressed
- This document is for use on all handheld products so some of the steps do not apply, and in some cases the technician may be required to move ahead and back to get all the steps done



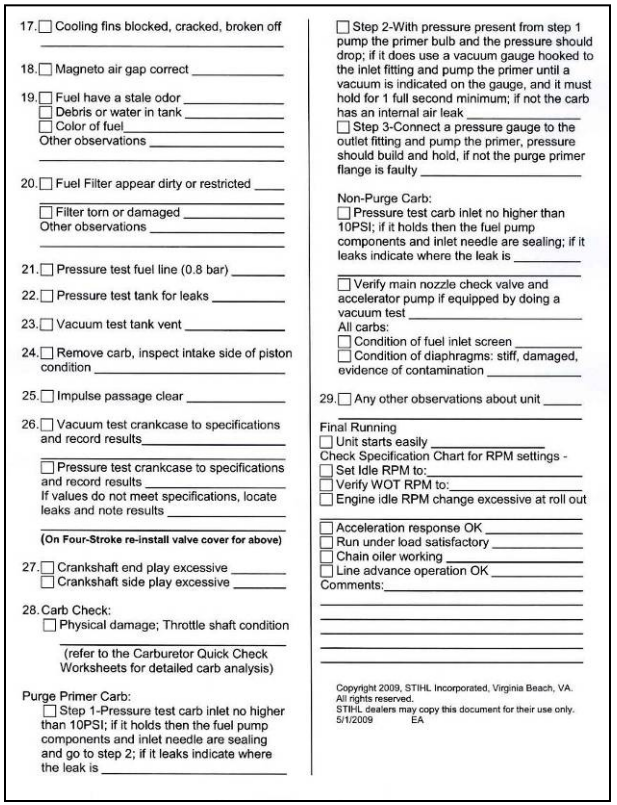
STIHL®

STIHL Engine Check

Customer Name:_____ Date: _____
Model #_____ Serial # _____
Service Technician:_____ Work Order # _____
Customer Comments: _____

Detailed Fault Analysis –

1. ☐ Deflectors, shrouds, covers _____
   ☐ Fasteners loose or missing _____
   Other observations _____
2. ☐ Warning Labels _____
3. ☐ Cutting Attachment: Note type & condition; any accessories present? _____
4. ☐ Belt tension and condition (TS)_____
5. ☐ Throttle operates smoothly _____
   ☐ Multi-Function lever works smoothly _____
   ☐ Chain brake actuates properly
   ☐ Throttle interlock works properly
   ☐ Choke operates properly
   Other observations _____
6. ☐ AV system condition _____
7. ☐ Starter rope worn, frayed, length & diameter OK _____
8. ☐ Air Filter worn or damaged _____
   ☐ Air Filter packed with dirt or debris _____
   Other observations _____
9. ☐ Dirt or debris on clean side of filter _____
   ☐ Evidence of dirt in carburetor bore or on choke butterfly _____
   Other observations _____
10. ☐ Carburetor Screw Settings:
    Limiter Caps Present if equipped_____
    Verify settings if caps are missing or unit does not use limiter caps:
    H_____ L _____
11. ☐ Spark plug connection, terminal spring, and high-tension lead condition _____
12. ☐ Spark present with STIHL ZAT4 tester
    No - install new plug and retest _____
    Other observations _____
    ☐ Ignition shut off function _____
13. ☐ Spark plug correct heat range _____
    ☐ Spark plug carbon fouled _____
    ☐ Sooted over _____
    ☐ Normal in appearance _____
    ☐ Spark plug gap _____
    Other observations _____
14. ☐ Muffler condition _____
    ☐ Spark arrester screen blocked or missing _____
    Other observations _____
15. **Four-Stroke Only**:
    ☐ Valve clearance OK _____
    ☐ Leak Down Test % of leakage _____
    If over 10%, location of leakage _____
16. **Two-Stroke Only**: Remove Muffler-
    ☐ Carbon deposits in exhaust port _____
    ☐ Piston condition _____
    ☐ Piston rings free _____
    ☐ Cylinder wall condition _____
    Other observations _____



17. ☐ Cooling fins blocked, cracked, broken off _____
18. ☐ Magneto air gap correct _____
19. ☐ Fuel have a stale odor _____
    ☐ Debris or water in tank _____
    ☐ Color of fuel _____
    Other observations _____
20. ☐ Fuel Filter appear dirty or restricted _____
    ☐ Filter torn or damaged _____
    Other observations _____
21. ☐ Pressure test fuel line (0.8 bar) _____
22. ☐ Pressure test tank for leaks _____
23. ☐ Vacuum test tank vent _____
24. ☐ Remove carb, inspect intake side of piston condition _____
25. ☐ Impulse passage clear _____
26. ☐ Vacuum test crankcase to specifications and record results_____
    ☐ Pressure test crankcase to specifications and record results _____
    If values do not meet specifications, locate leaks and note results _____
    (On Four-Stroke re-install valve cover for above)
27. ☐ Crankshaft end play excessive _____
    ☐ Crankshaft side play excessive _____
28. Carb Check:
    ☐ Physical damage; Throttle shaft condition _____
    (refer to the Carburetor Quick Check Worksheets for detailed carb analysis)

Purge Primer Carb:
☐ Step 1-Pressure test carb inlet no higher than 10PSI; if it holds then the fuel pump components and inlet needle are sealing and go to step 2; if it leaks indicate where the leak is _____

☐ Step 2-With pressure present from step 1 pump the primer bulb and the pressure should drop; if it does use a vacuum gauge hooked to the inlet fitting and pump the primer until a vacuum is indicated on the gauge, and it must hold for 1 full second minimum; if not the carb has an internal air leak _____
☐ Step 3-Connect a pressure gauge to the outlet fitting and pump the primer, pressure should build and hold, if not the purge primer flange is faulty _____

Non-Purge Carb:
☐ Pressure test carb inlet no higher than 10PSI; if it holds then the fuel pump components and inlet needle are sealing; if it leaks indicate where the leak is _____
☐ Verify main nozzle check valve and accelerator pump if equipped by doing a vacuum test _____
All carbs:
☐ Condition of fuel inlet screen _____
☐ Condition of diaphragms: stiff, damaged, evidence of contamination _____

29. ☐ Any other observations about unit _____

Final Running
☐ Unit starts easily _____
Check Specification Chart for RPM settings -
☐ Set Idle RPM to:_____
☐ Verify WOT RPM to:_____
☐ Engine idle RPM change excessive at roll out _____
☐ Acceleration response OK _____
☐ Run under load satisfactory _____
☐ Chain oiler working _____
☐ Line advance operation OK _____
Comments:_____

DG Screws

- STIHL uses these type of fasteners in manufacturing because they cut their own threads the first time they are used
- Notice that the ones holding into plastic have a different pitch and profile than the ones that hold into metal
- It is imperative that the Service Technician keep track of which screw is which and not screw them into the wrong base material or the threads will be damaged
- It is also best practice that when starting a DG screw into the hole, slowly rotate it backwards until it “clicks” to index the threads, then turn it clockwise to tighten it

For Plastic For Metal

1. Deflectors, Shrouds, Covers, Fasteners

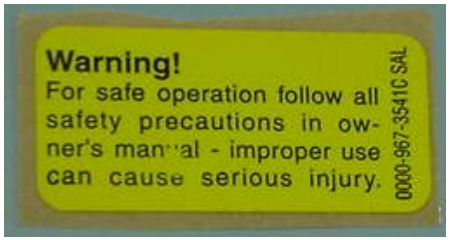
- Visually look the unit over for damage, missing items, loose fasteners, or anything else that is obvious

- Damaged shroud may be a safety hazard for the operator

- Operated without an air filter or cover

2. Warning Labels

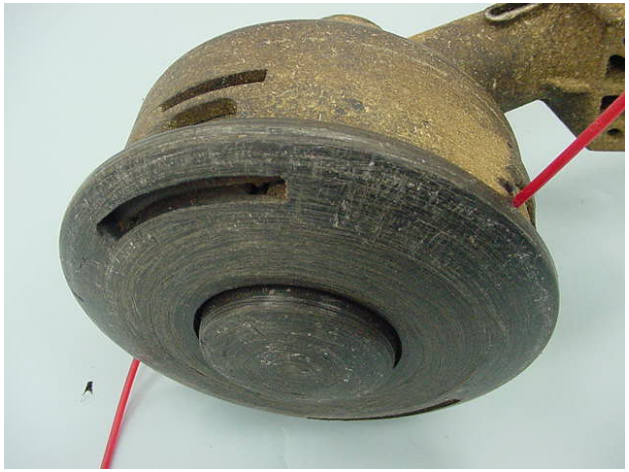
- Verify that labels are present and readable, replace as needed
- If this label is damaged or worn away, a universal replacement label is available from STIHL
  - Yellow Power Tool Label: 0000 967 3541

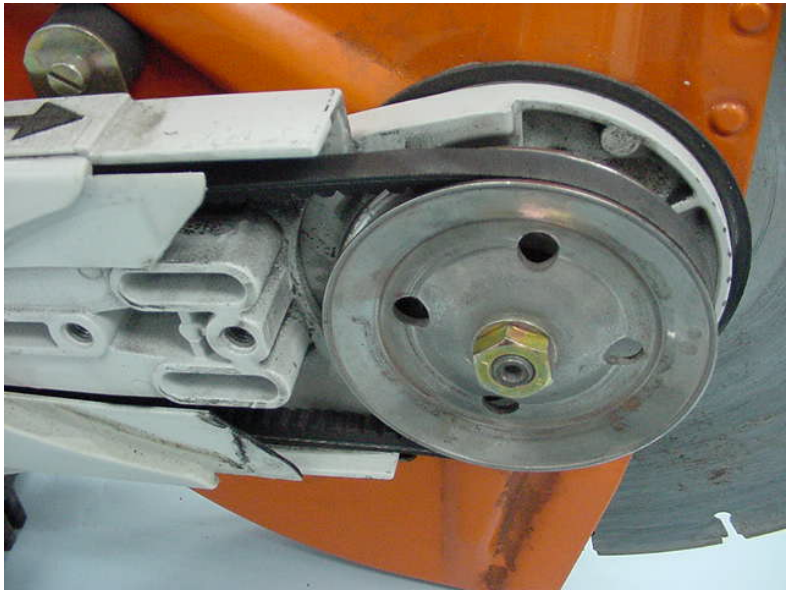


3. Cutting Attachment

4. Belt Tension

- For this KM 56 RC these do not apply so just draw a line through them and continue to the next item



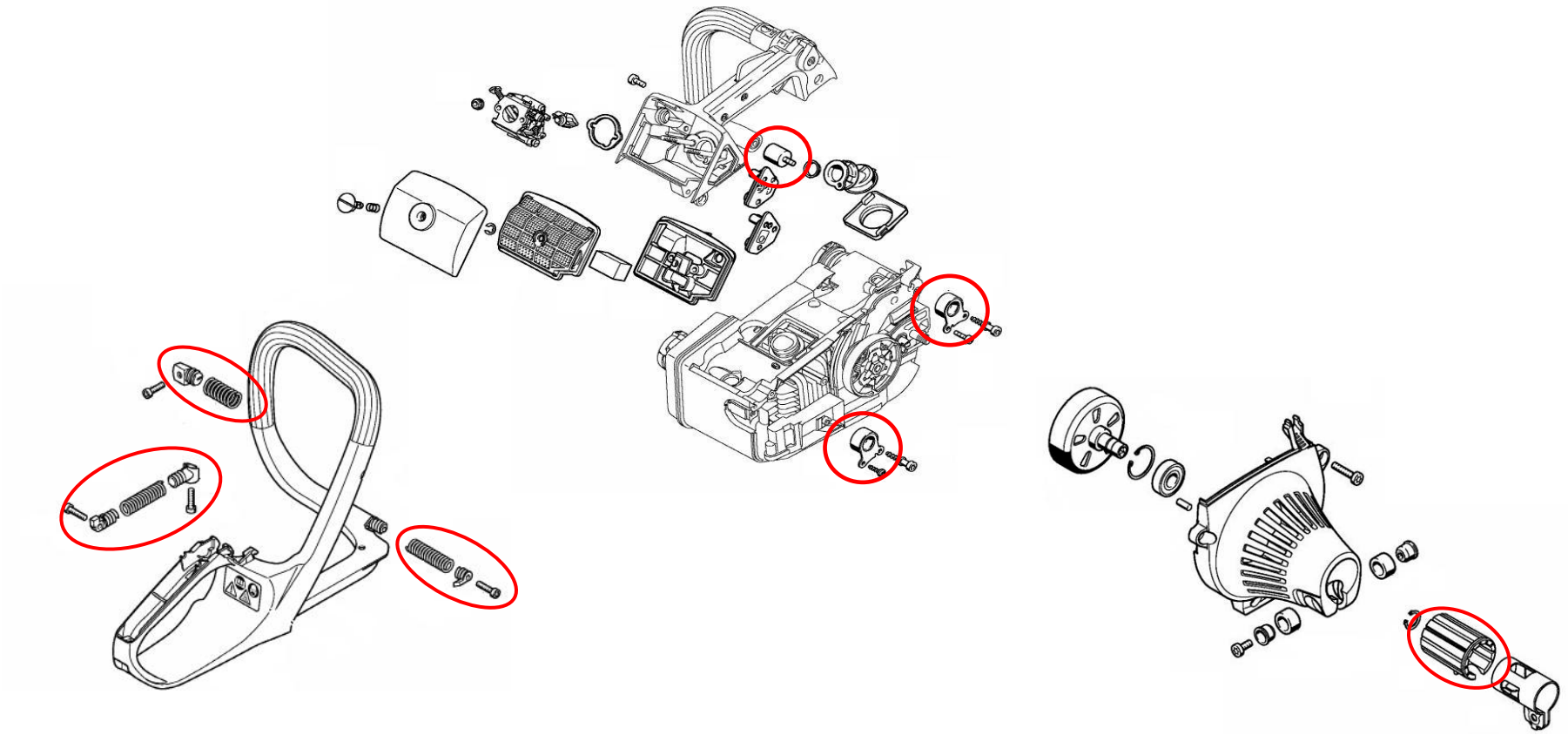


5. Operator Controls

- Be sure the throttle trigger and throttle interlock works freely
- Verify the stop switch when pushed to the O position and released, it springs back to the run position
- Rotate the choke knob to the full on position and then squeeze the throttle trigger and the choke knob should automatically return to the run position

6. Verify Anti-vibration Components

- Most STIHL chain saws and line trimmers have a anti-vibration system that should be inspected for wear and damage
- The KM 56 RC-E does have an anti-vibration system, so continue to next item



7. Inspect Starter System

- Inspect rope, handle, and eyelet for wear or damage

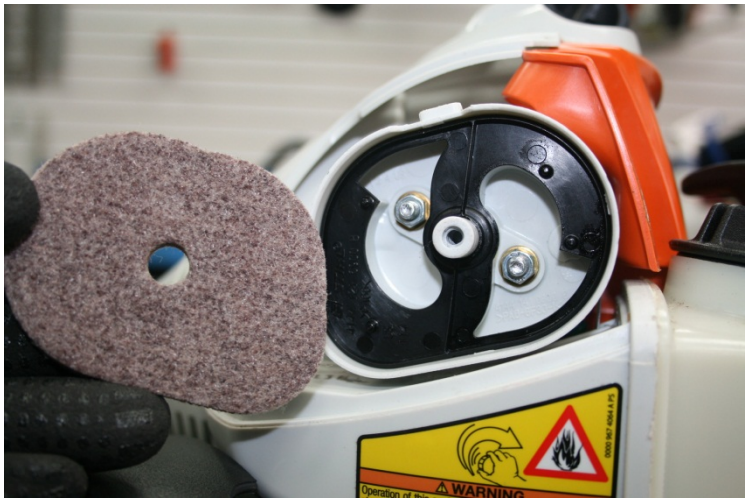
- Pull the rope to it’s full extended length and be sure it is not about to break at the very end

8. Inspect Air Filter

- Remove the air filter cover to expose the air filter
- Gently pry out the filter for inspection

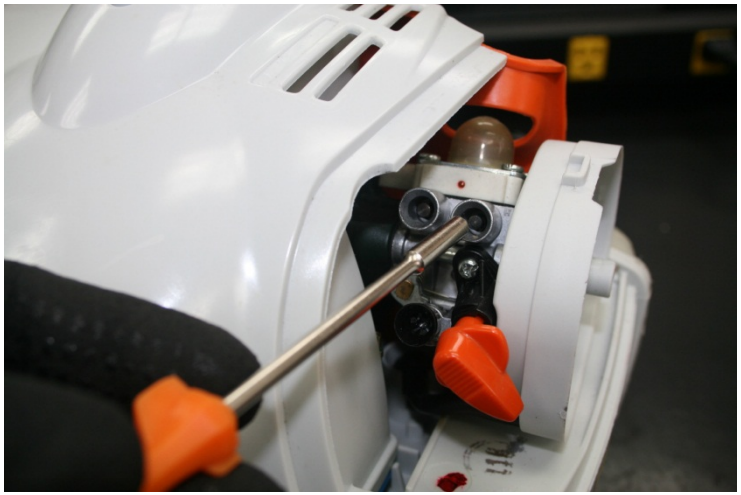
9. Inspect Air Filter Housing

- The black plastic baffle directs and accelerates the clean air into the carburetor
- Remove the baffle and check behind it and down into the throat of the carburetor
- The clean side of the filter should not have any dirt or debris present
- If there is dirt on the clean side indicate this as a dirt ingestion fault and the cause must be identified
  - Dirty operating conditions require filter maintenance
  - Verify that the cover, filter or filter housing are not damaged allowing dirt to leak in around the filter



10. Carburetor Mixture Screws

- All current STIHL products will be equipped with either limiter caps or tamper resistance screws on the H and L mixture screws
- This unit requires a special thin wall socket screwdriver to adjust the mixture screws
- This is a special tool and is not available to the consumer
- The basic settings for this carb is:
  H – 1 ½ turns open
  L – 1 turn open

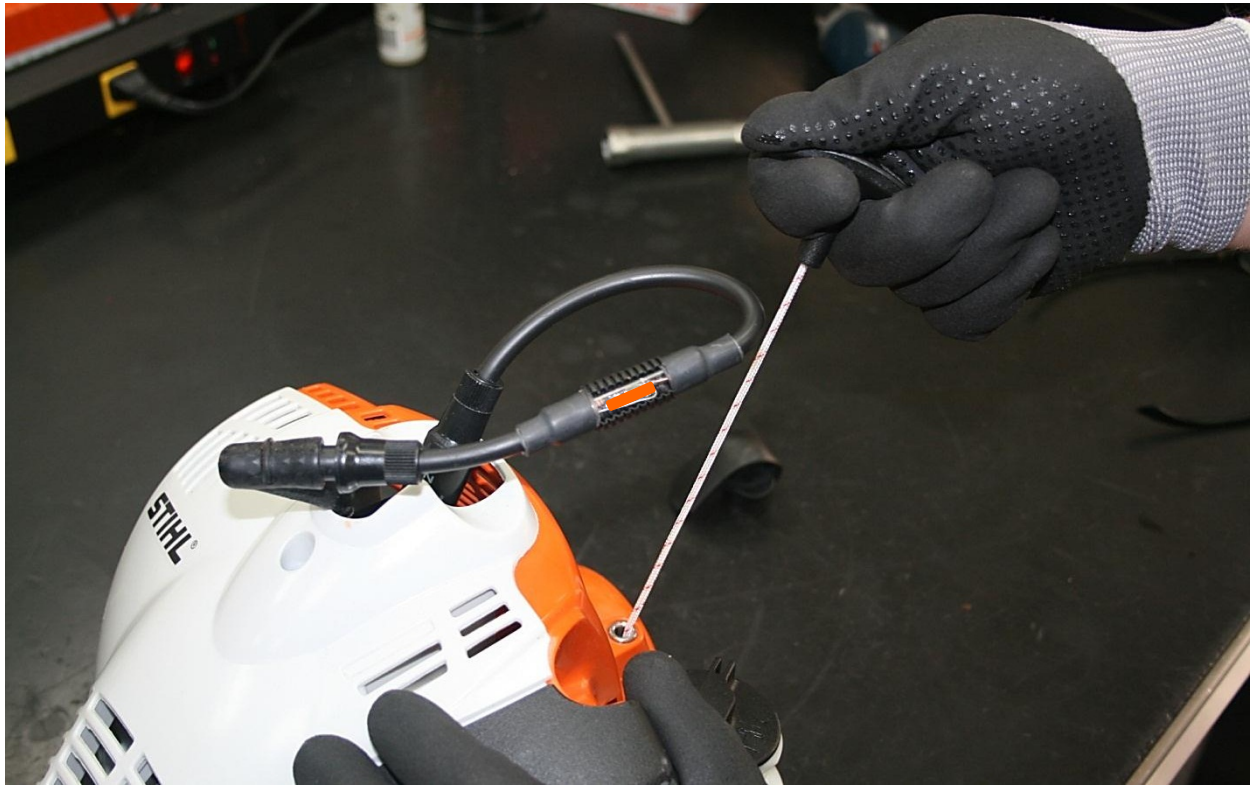


11. Spark Plug Connection

- Use a twisting motion to remove the spark plug connection and be careful not to pull the clip out of the high tension lead
- Inspect it for damage, hardness or cracks

12. Spark Test

- Connect a ZAT 4 or equivalent in line spark tester and pull the rope through as if trying to start the engine
- A bright orange light indicates the ignition is firing the spark plug
- If no spark is present try again with a new plug
  - A fouled or defective spark plug may not show spark on the tester even if the ignition system is OK



12. Ignition Shut-Off Function

- If spark is present then hold the stop switch in the off position and pull the rope through and verify that no spark is present
- This verifies that the stop switch and connecting wiring is in order

13. Spark Plug

- Remove the plug and verify that is the correct plug
  - For a KM 56 RC-E the correct plug is a NGK CMR6H, part number 0000 400 7011
  - If another brand of plug is installed or used use a cross reference chart to be sure it has the same heat range as the NGK CMR6H

Normal tan color, normal electrode wear due to high run time. Plug has served its useful life.

14. Muffler

- Remove the top engine housing
- Remove the spark arrester screen and inspect, it should not be blocked up with carbon deposits
- After removing the muffler inspect it and the exhaust gasket for damage and verify that the engine has not been running with the muffler bolts loose

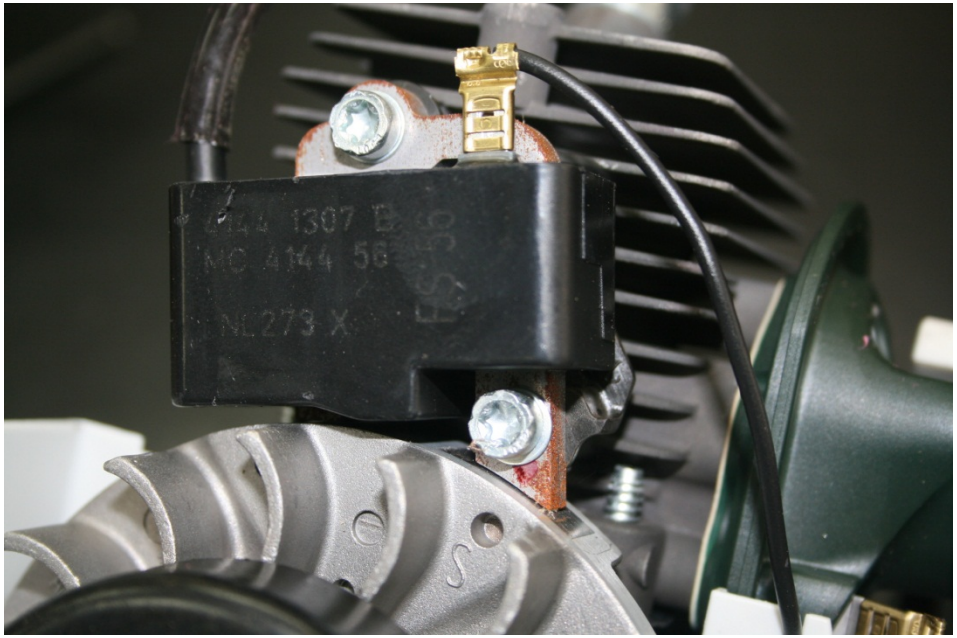
16. Inspect Exhaust Port and Piston

- With the muffler removed use a flashlight and look through the exhaust port to be sure the port is not clogged up with carbon deposits
- Move the piston up and down and inspect the surface of the piston skirt for scoring or damage
  - A piston in good condition will still have the radial machine marks across the skirt indicated little or no wear
- Try to observe if the rings are moving slightly when the piston is moved up and down, indicating that they are free in the lands
- Inspect the intake side of the cylinder wall for wear or damage

17. Cooling System

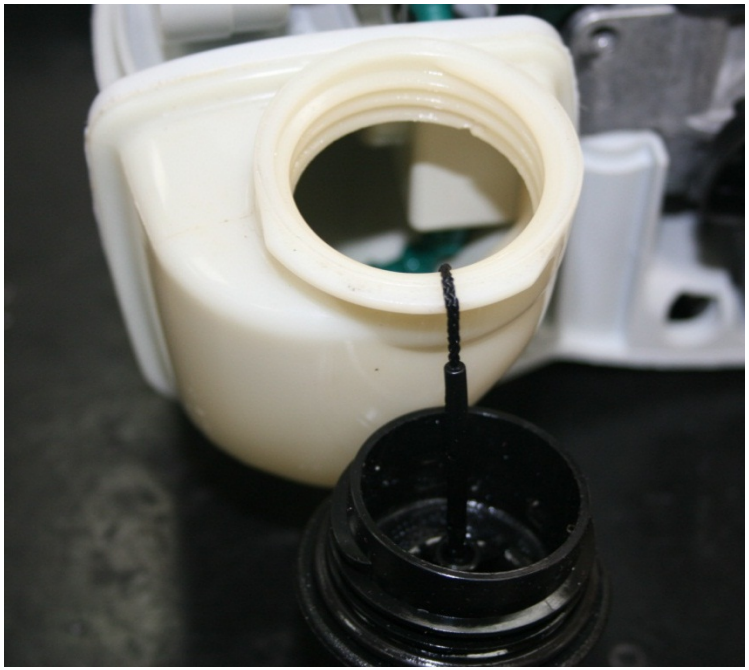
18. Magneto Air Gap

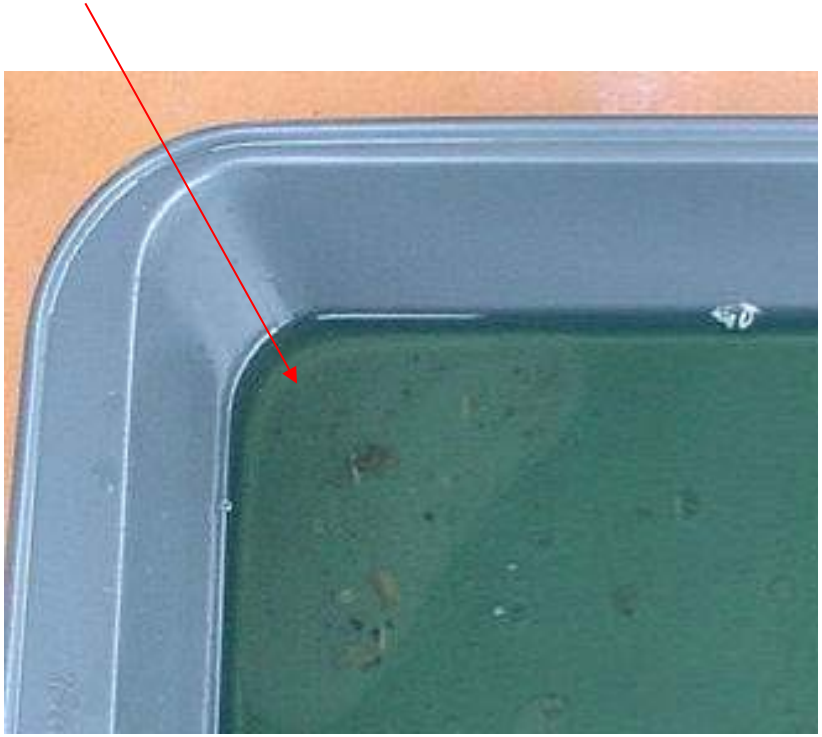
- Verify that the cooling fins are in good condition and that the air path to the flywheel and through the engine from the flywheel is not blocked or restricted in any way
- Line up the pole shoes in the flywheel with the magneto
- Observe the gap between the ignition module and the flywheel
  - The specification is .008”
  - It is not absolutely necessary to measure this with a gauge, just be sure the flywheel is not rubbing on the module and that the gap does not look excessively wide



19. Fuel Tank

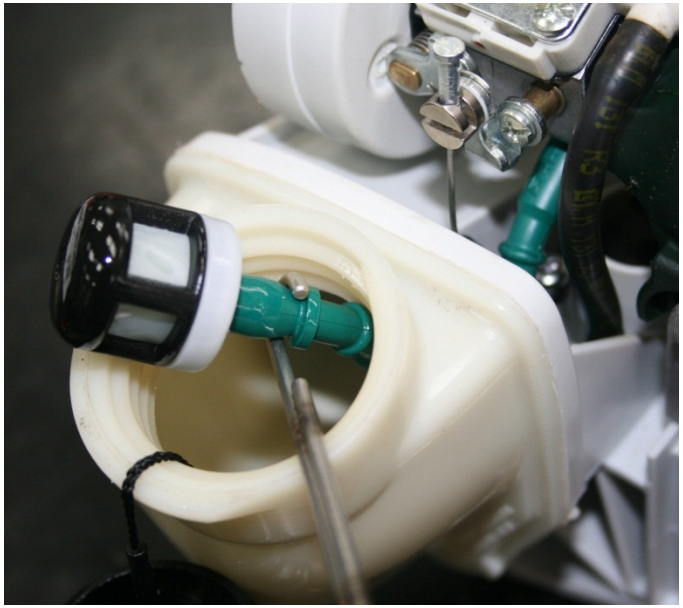
- If the tank is empty look down in the tank to see if it appears contaminated with debris or anything else that shouldn't be there
- If the unit has fuel in it carefully remove the cap and wave your hand over the opening while smelling for a sour odor that may indicate old stale fuel
- Pour the fuel out in a pan and see if there is trash or debris, or any evidence of other contaminants such as water in the fuel

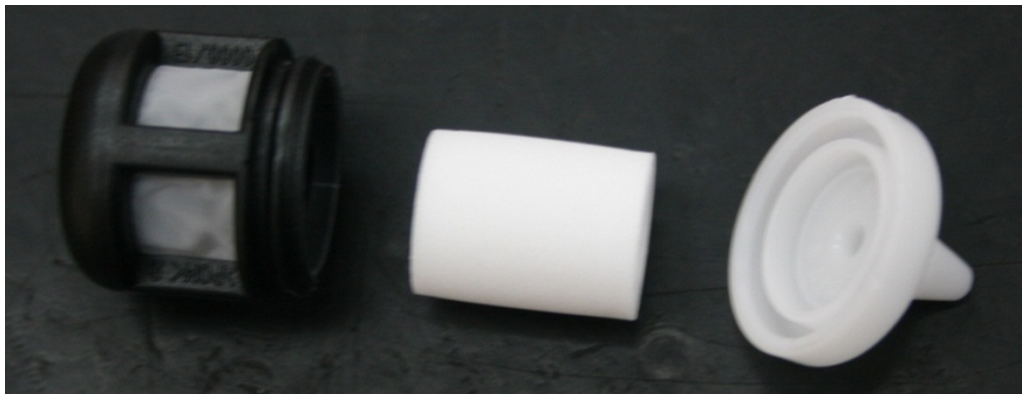




20. Fuel Filter

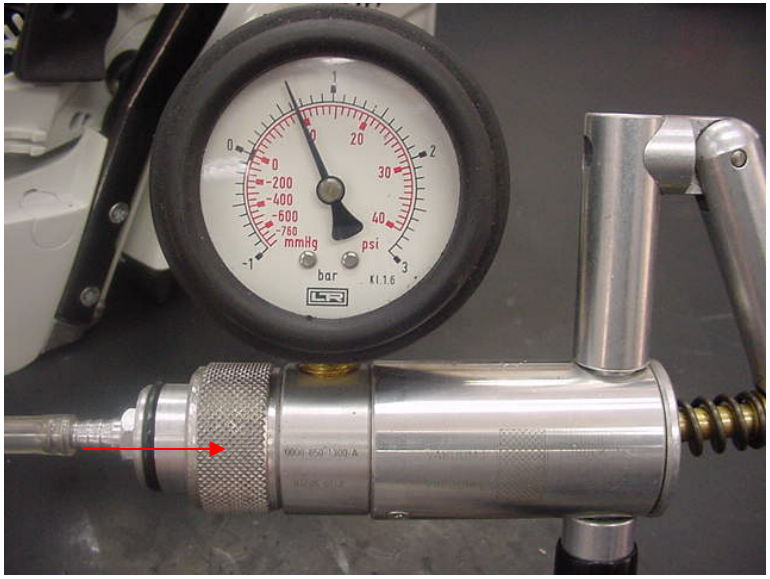
- Use the 5910 893 8800 hook tool to fish the fuel filter out of the tank for inspection
- Carefully remove the top of the filter and slide the sintered plastic element out
- The filter body screen should be clear and in good condition, and the element may have oil staining but should not be dark or fouled or have any kind of coating on it

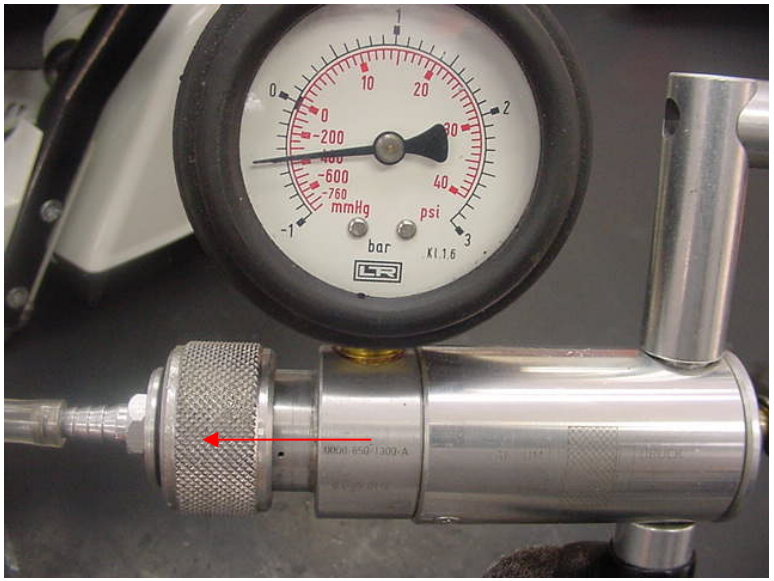




Pressure Vacuum Tester

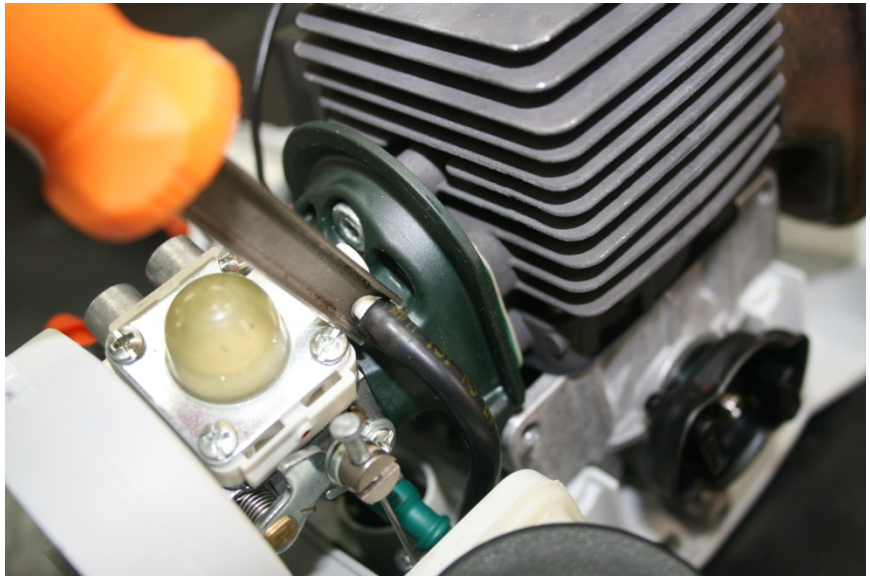
- 0000 850 1300 Pump
- With the knurled ring to the right the gauge indicates pressure
- With the knurled ring to the left the gauge indicates vacuum

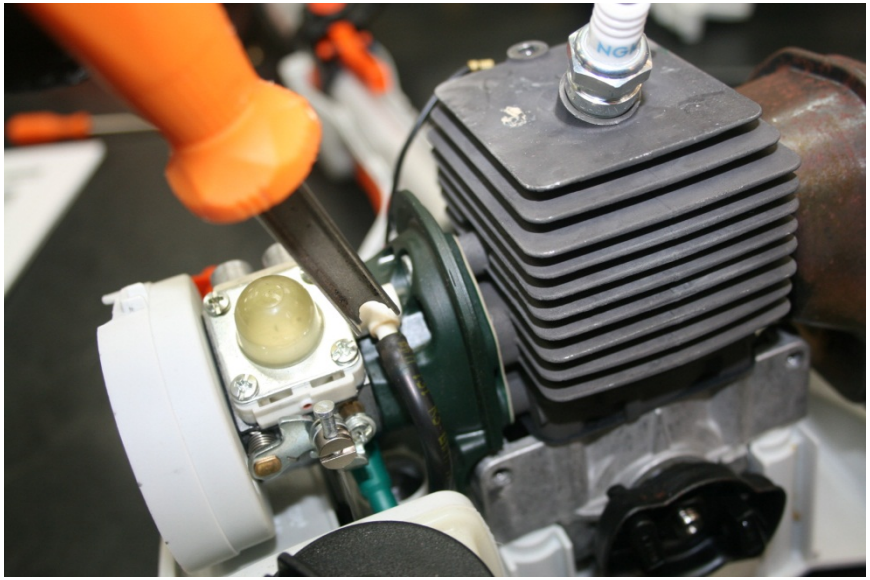




Hose Removal

- The 5910 890 4501 tool works well to remove fuel, impulse, or vent hoses

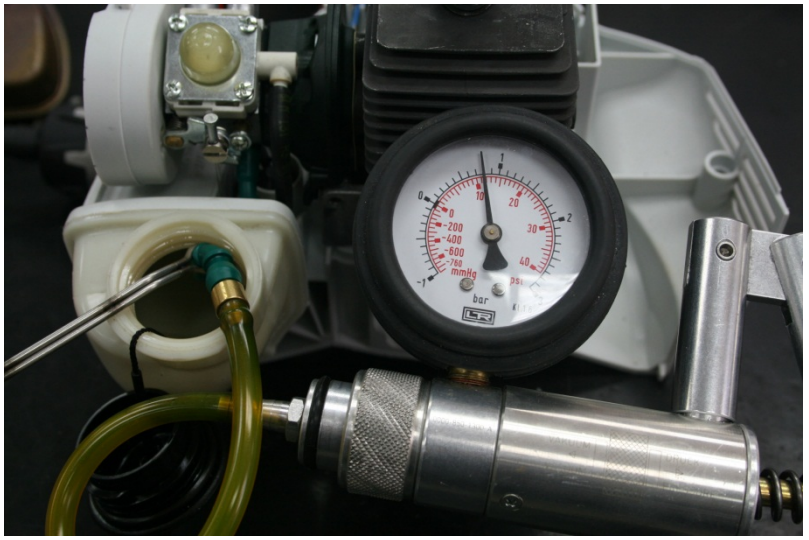


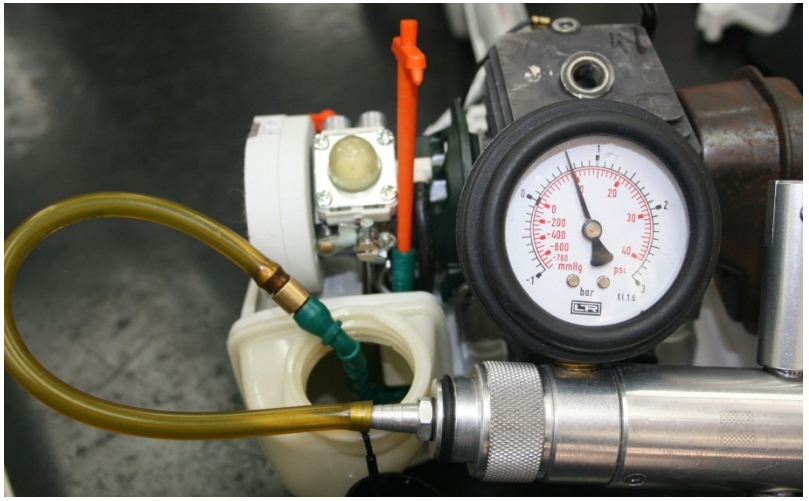


- Use a side to side rocking motion while pushing against the hose to walk it off of the fitting

21. Pressure Test Fuel Line

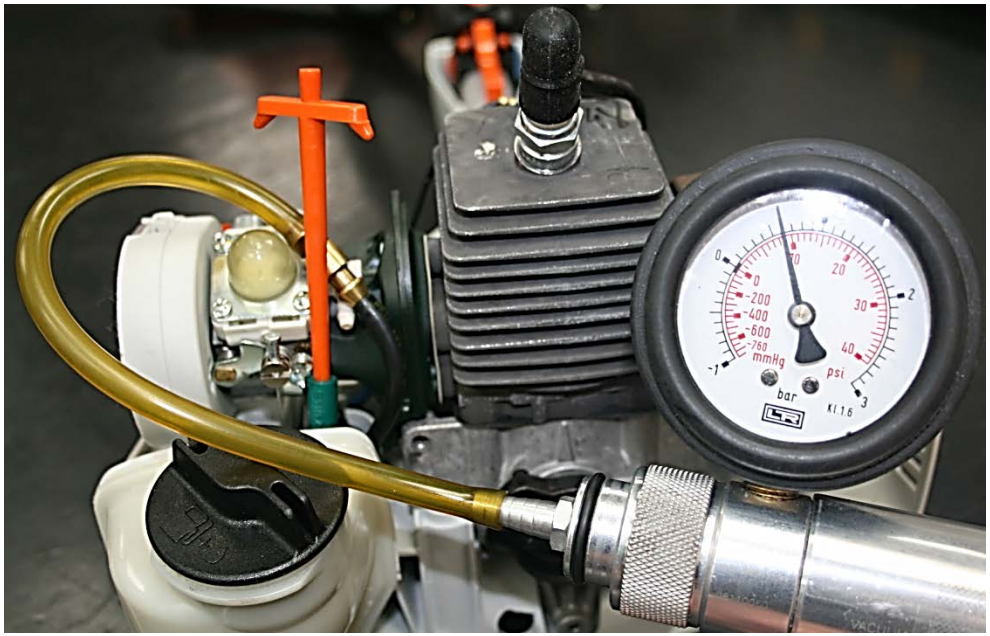
- Connect the pressure tester to the fuel line where the filter was removed and gently pump it up no higher than 10 PSI
- If it holds steady then the fuel hose in the tank and the carb itself passes the pressure test
- If it fails the molded hose in the tank, must be isolated and tested separately to see if there is a leak in the hose or the carb
- It is possible that the hose in the tank may have a hole or tear in it, so the engine would run OK until the fuel level dropped to the point where the air in the tank would enter the hose, leading to lean running even though the tank still had fuel in it





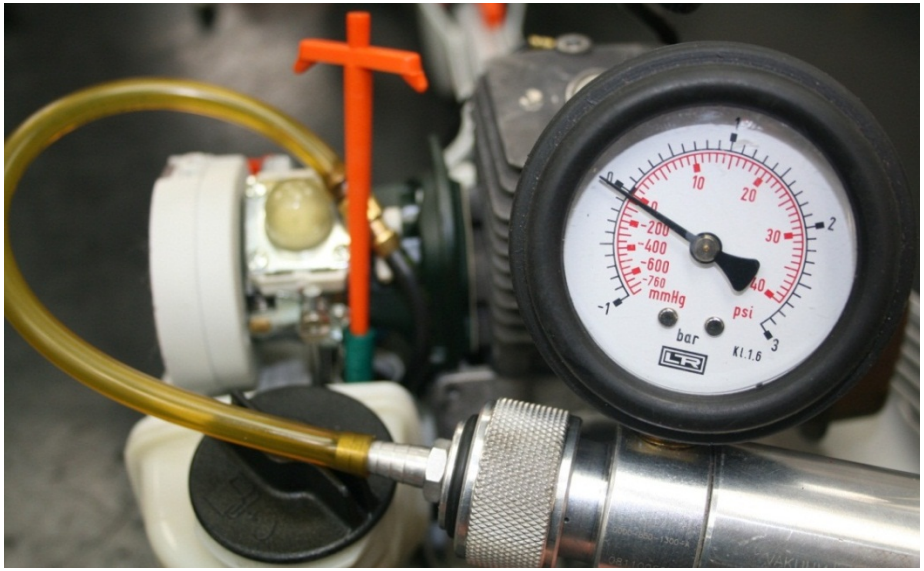
22. Pressure Test Tank

- Be sure there is no fuel in the tank before applying any pressure to the fuel tank!
- The pressure test verifies that the tank does not have a leak in any location, such as a grommet, seam, cap or hose
- Block off one of the two hoses coming from the tank connector and pressure test through the other
- Apply 3 to 4 pounds of pressure and it must hold steady
- If it leaks down at all use soapy water in a spray bottle to locate where the leak is



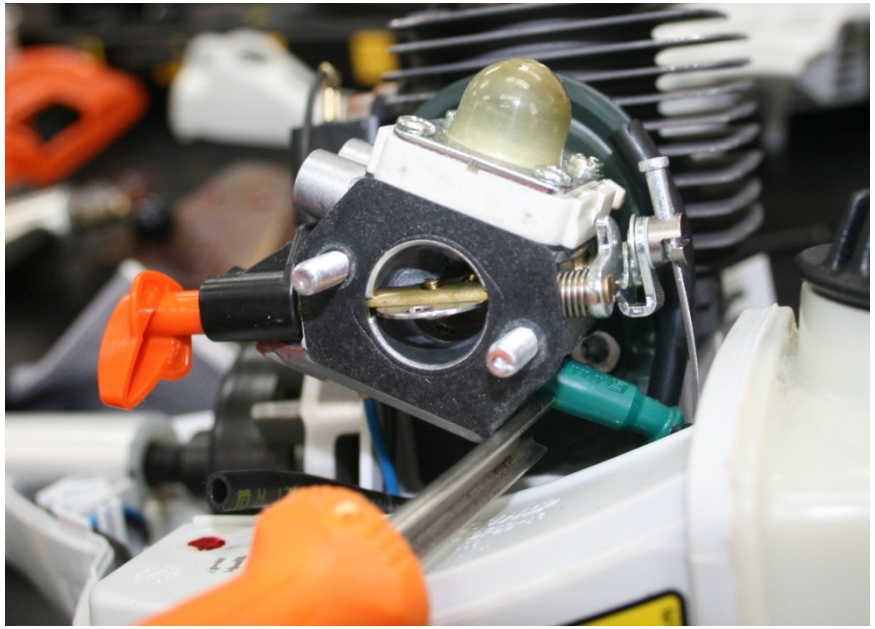
23. Vacuum Test Tank Vent

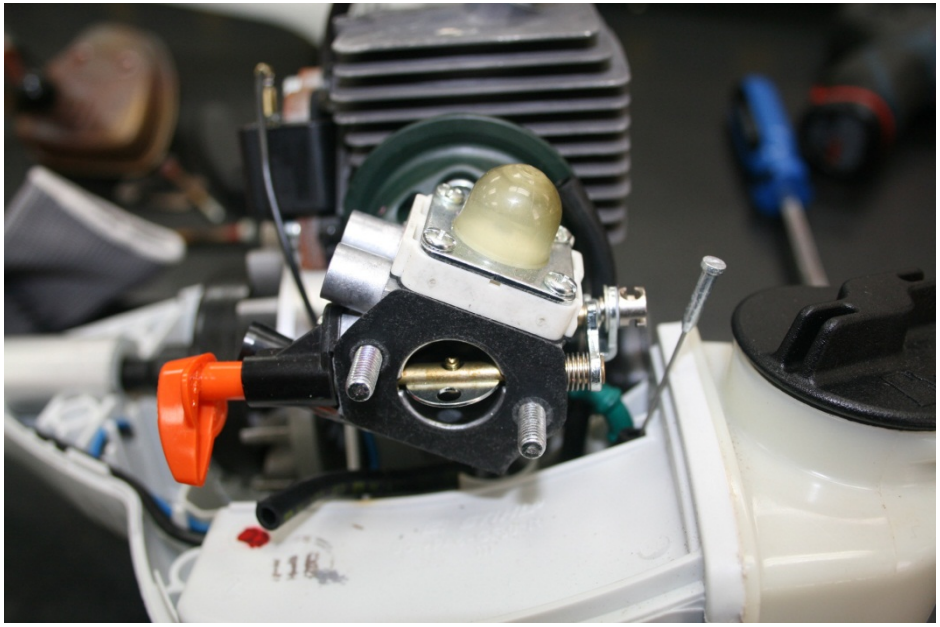
- The tank vent on the KM 56 RC-E is a one-way check valve that will not let fuel leak out under pressure, but will allow air into the tank as the fuel level goes down, so no vacuum builds up leading to fuel starvation
- Reverse the tester into vacuum mode and pump hard and fast to see the needle indicate that some negative pressure is present in the tank
- Watch the gauge and the needle should move back up towards zero rapidly
- If the needle does not leak back to zero quickly the tank vent must be replaced and then re-test



24. Inspect Intake Side Of Piston

- Remove the carburetor, which will require removal of the fuel hoses and undo the throttle link from the trigger
- Pay attention to how the linkage hooks up and routing of the hoses

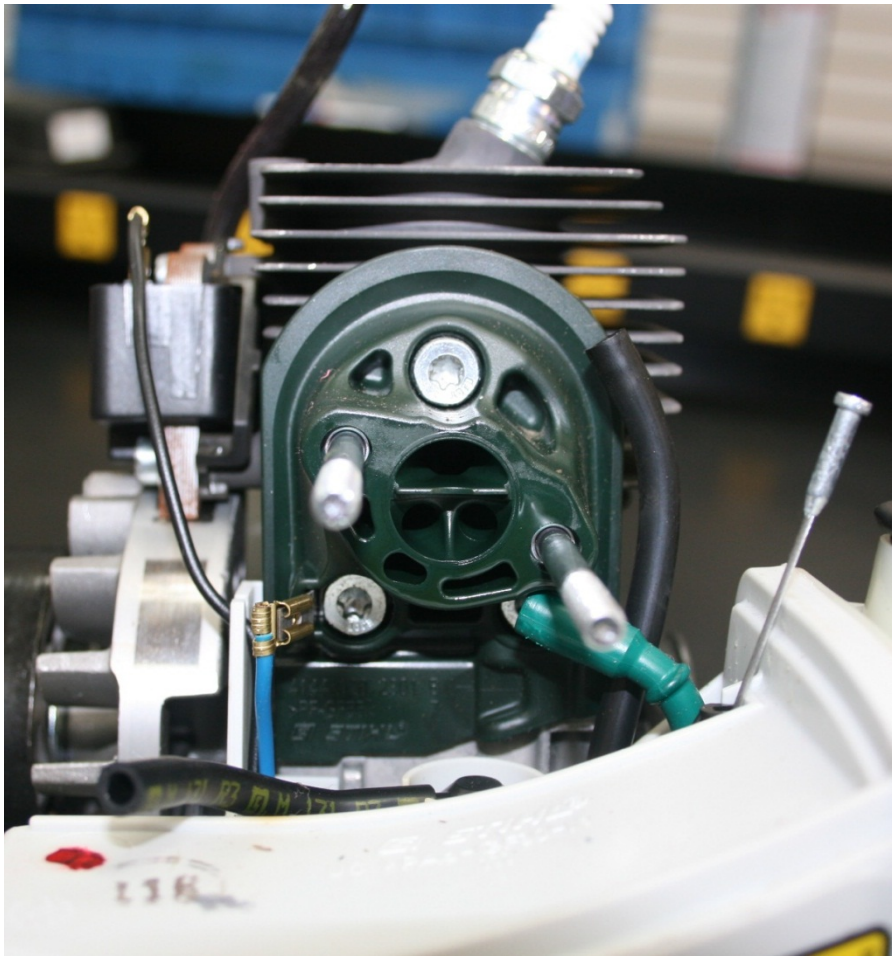




24. Inspect Intake Side Of Piston

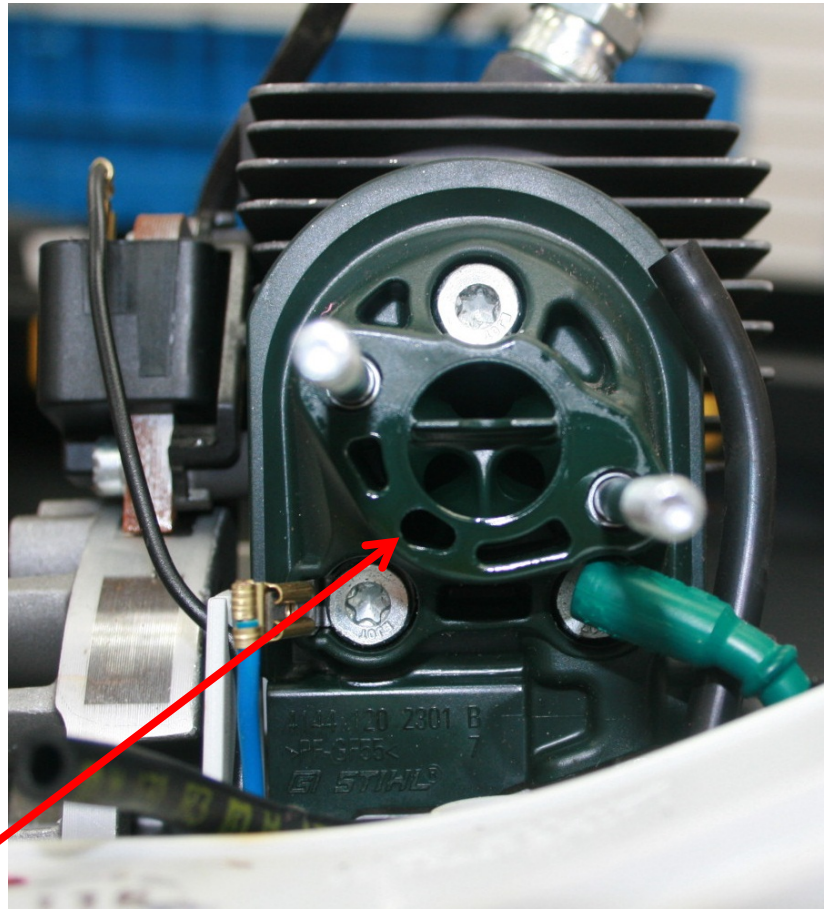
- On most two-stroke engines the intake side of the piston can be inspected through the intake port, but on the KM 56 RC-E, due to the stratified scavenge design, the flange does not allow the piston to be seen

- On this model skip ahead to the impulse signal test and the crankcase pressure and vacuum test, then come back and remove the flange and inspect the piston



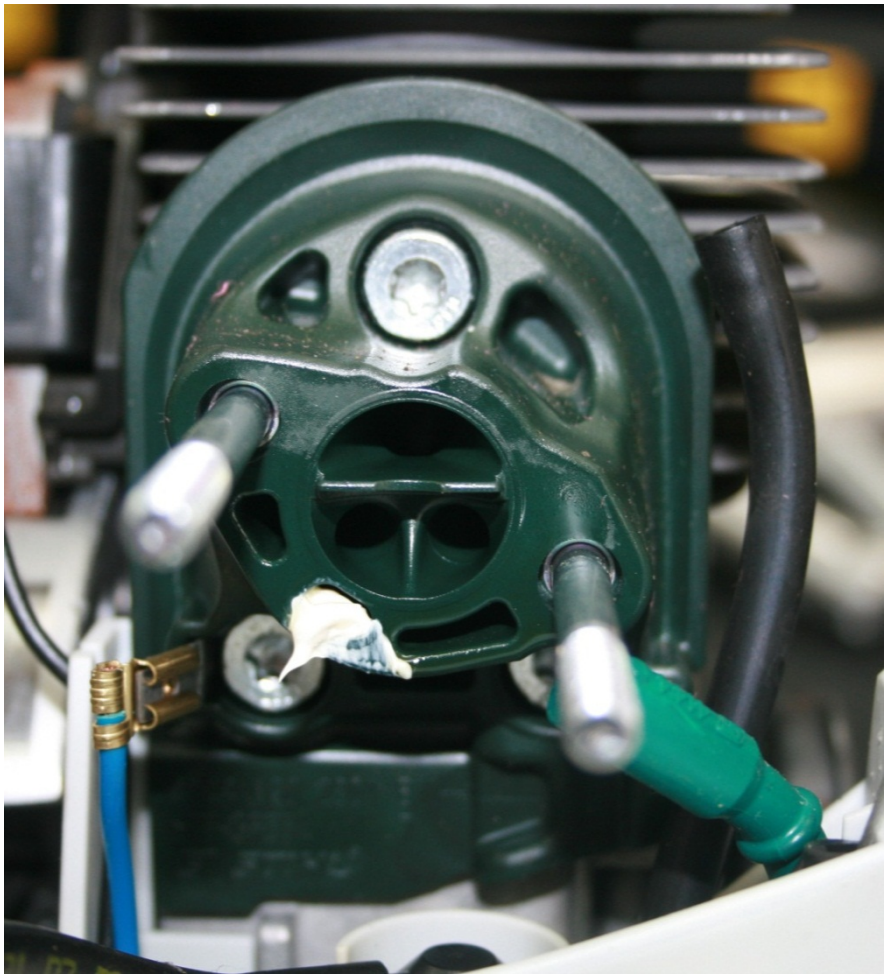
25. Impulse Signal Present

- Most two-stroke engines have a passageway between the crankcase and the fuel pump side of the carburetor to cause the fuel pump diaphragm to flex back and forth with the pressure/vacuum that is created by the piston moving up and down
- It is rare that there is no impulse signal, but always verify that it is present because no impulse signal will cause hard to diagnose unusual running behavior that will appear to be carburetor related
- For the KM 56 RC-E the impulse signal comes out through the flange here:



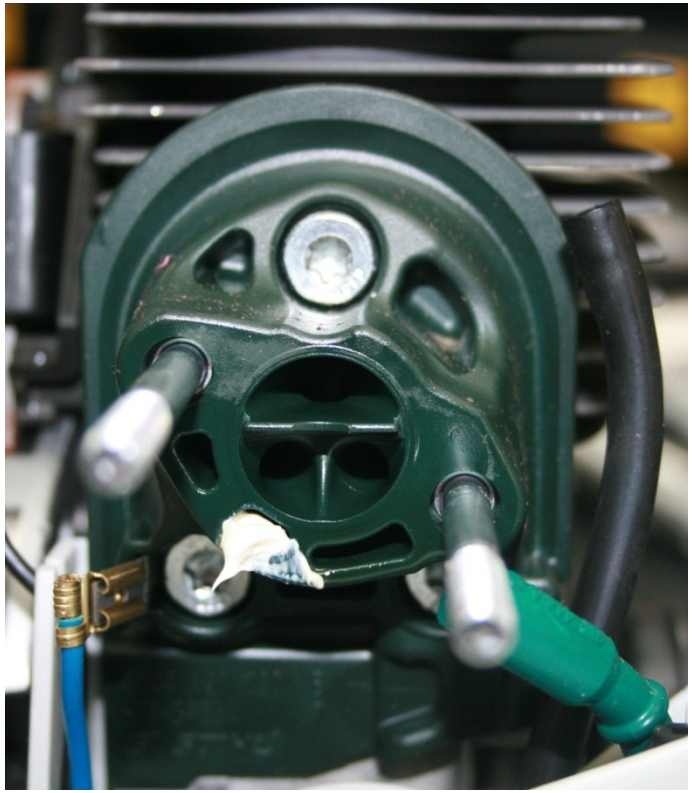
25. Impulse Signal Present

- Place a small amount of grease over the impulse port on the flange, just enough to cover it



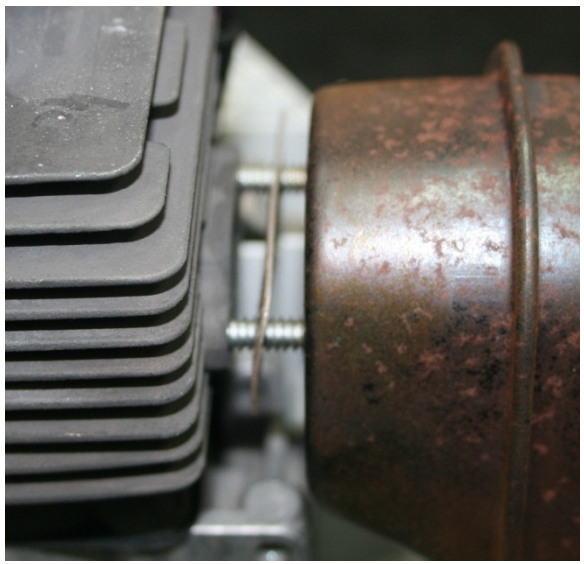
25. Impulse Signal Present

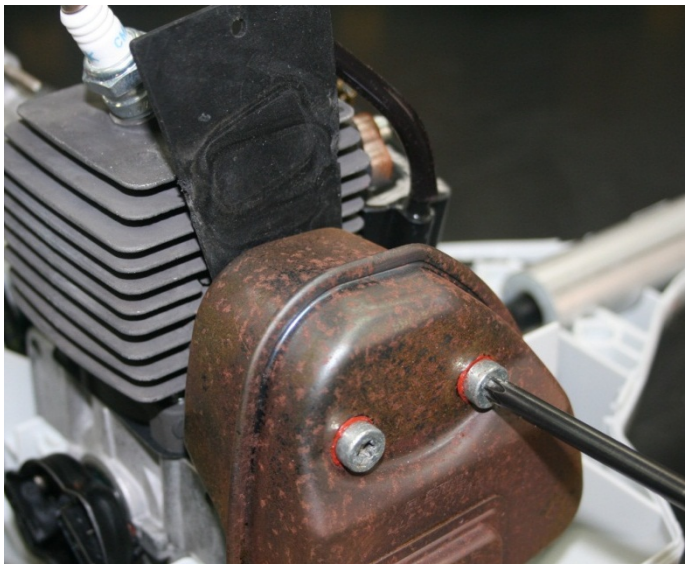
- Now watch the port carefully and spin the flywheel back and forth by hand and the grease should be either drawn in or pushed out, verifying that there is an impulse signal from the crankcase to the carb



26. Vacuum and Pressure Test of Crankcase

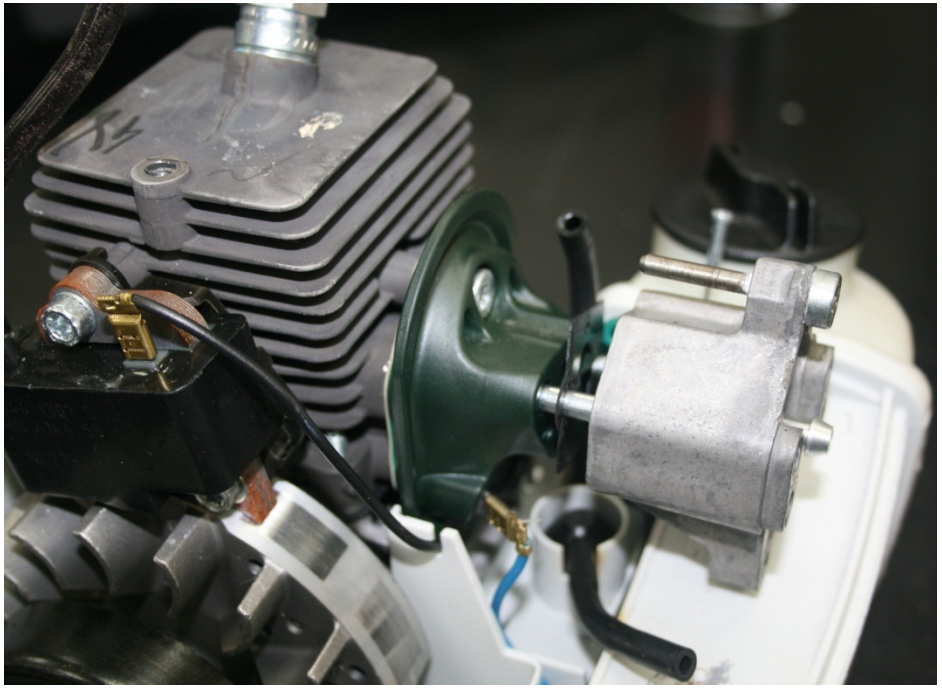
- A two-stroke engine typically must have an air tight, or nearly so, crankcase since the air fuel mix is coming through the crankcase on the way to the combustion chamber
- This test verifies that there are no pressure leaks at places like gaskets or RTV silicone sealed mating surfaces, and that the crankshaft seals are not leaking under pressure or vacuum
- Block off the exhaust port by starting the muffler screws in place and slipping a rubber block off plate in between the muffler and the cylinder, then snug up the screws making sure the rubber plate is covering the ex port





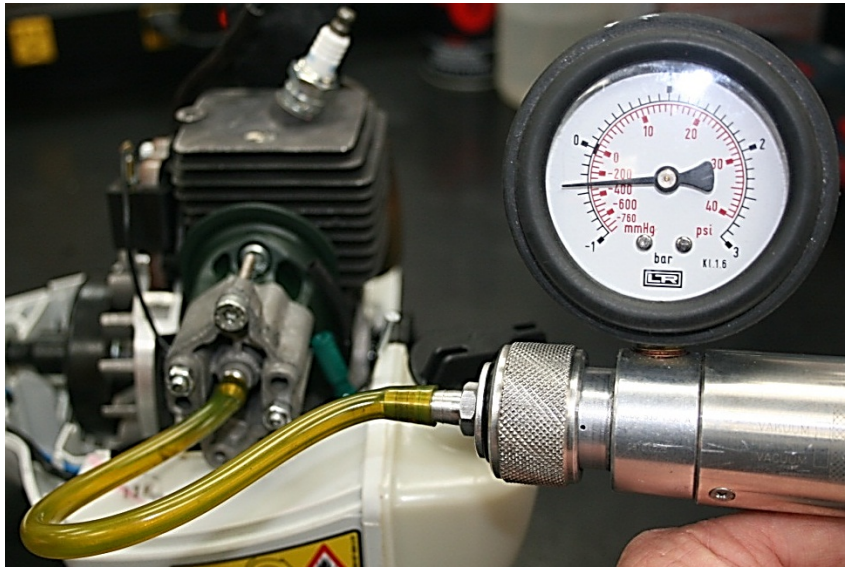
26. Vacuum and Pressure Test of Crankcase

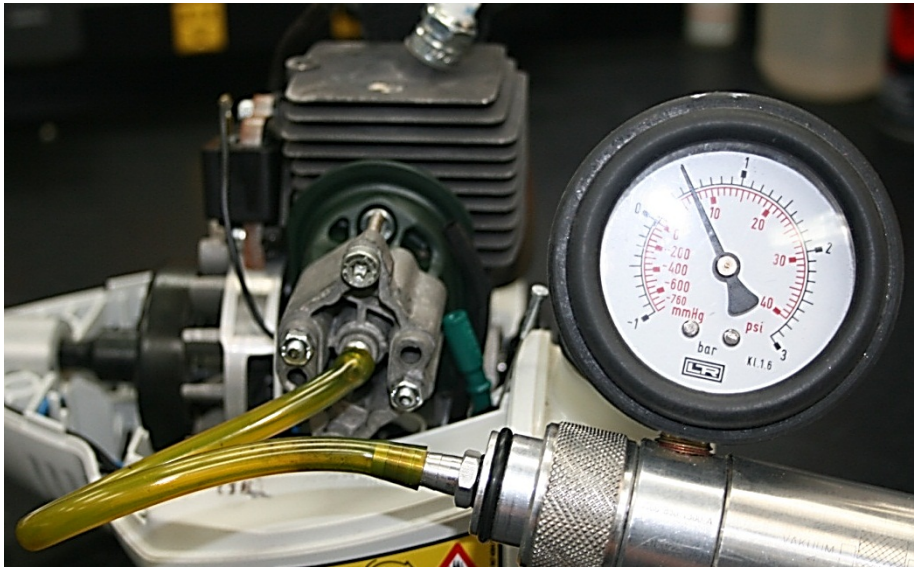
- Install the correct adapter flange in place of the carb
- The Service Manual for each model describes how to do this test and gives the part number for the adapter
- For the KM 56 RC-E the part number is 5910 850 4200
- Be sure the gasket is in good condition and in place
- Be sure the spark plug is installed and tight



26. Vacuum and Pressure Test of Crankcase

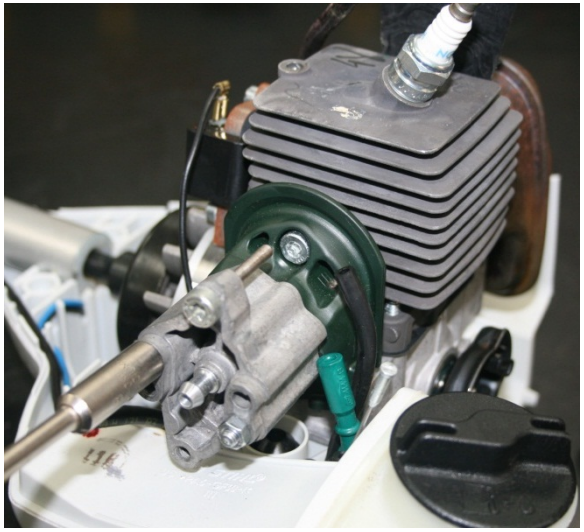
- Connect the pressure vacuum tester to the fitting on the flange and pull a 0.5 bar vacuum, and it should hold steady or not leak back to 0.3 bar within 20 seconds
- Always rotate the crankshaft back and forth while the crankcase is under vacuum to verify that the seals are holding properly
- Switch the tester to the pressure mode and pump 0.5 bar of pressure into the engine and it should hold steady for at least 20 seconds

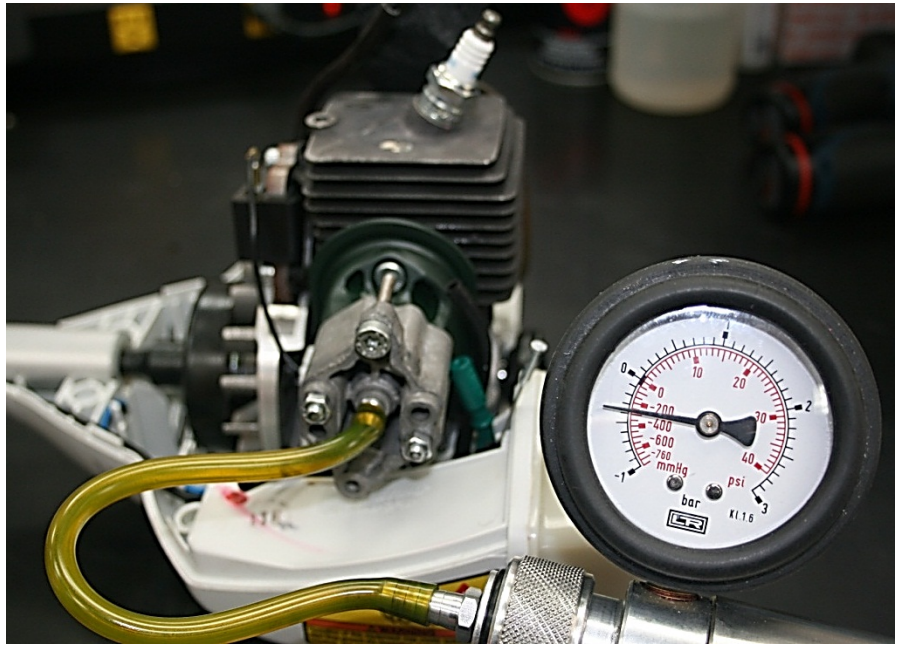




Pressure/Vacuum Test Results

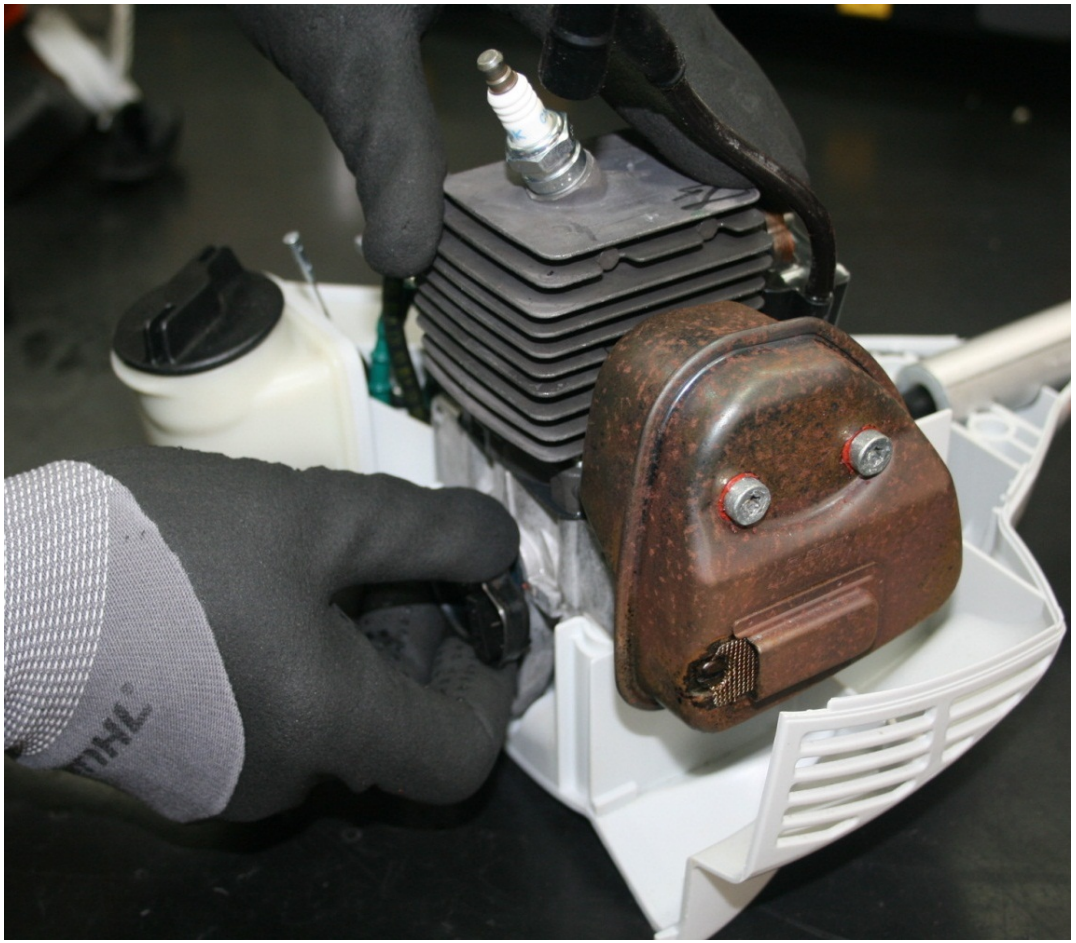
- This test verifies that there are no internal air leaks anywhere in the engine
- If the unit fails the pressure test always check the obvious things first, such as the rubber sealing plate on the ex and the adapter on the intake side, as well as the spark plug, by spraying with soapy water and looking for bubbles
- If they are sealing properly then the engine may need to be taken apart far enough to be able to check the crankshaft seals and the seal between the cylinder and the crankcase
- If an engine leaks under vacuum but holds under pressure it is most likely a crankshaft seal





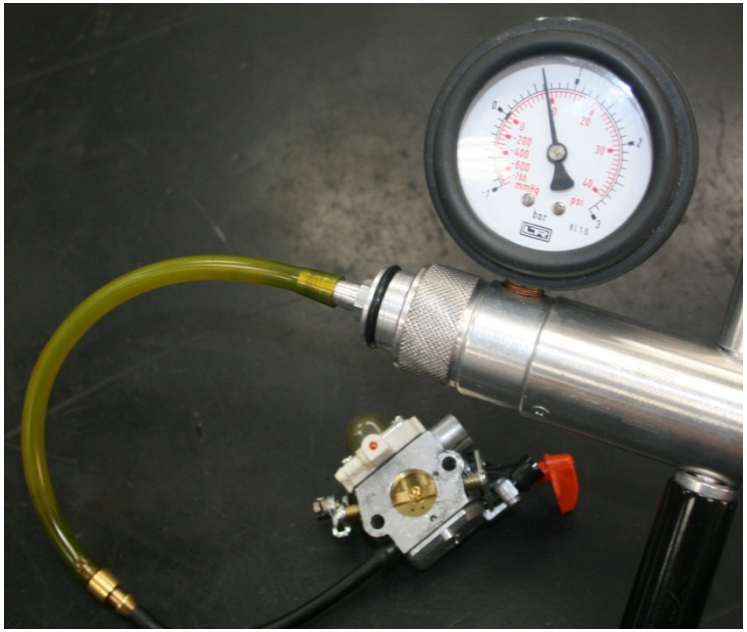
27. Crankshaft and Bearing Condition

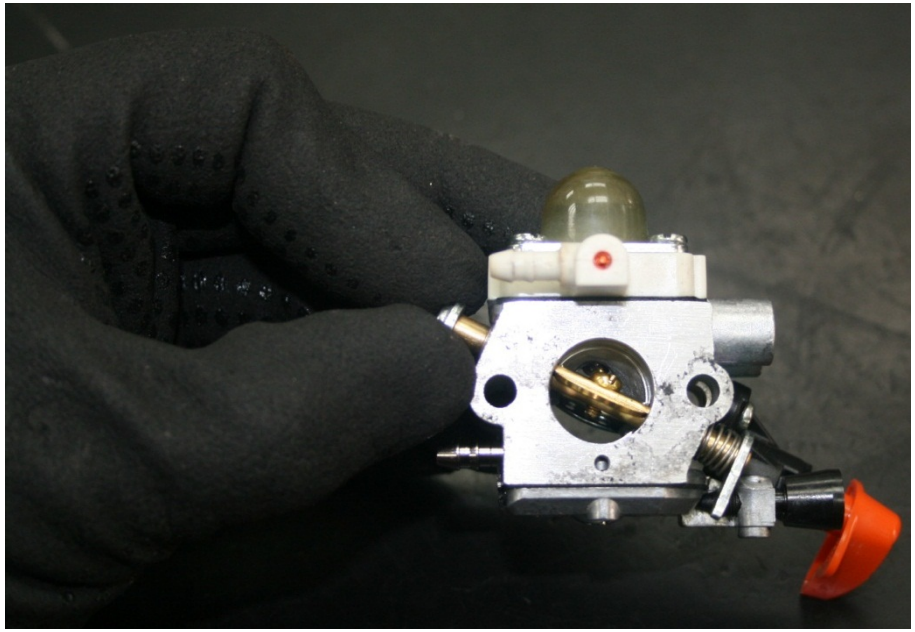
- See if the crankshaft moves in and out or up and down
- There should not be any loose play in the crankshaft bearings



28. Carburetor

- Pressure test the carb no higher than 10 PSI and it should hold steady
- Open and close the butterfly and it should open smoothly
- Verify that the throttle shaft does not have any excessive side to side play
- Inspect the carb for any physical damage





29. Other Observations; Final Running

- This is where any other observations about the unit not specifically covered by one of the numbered items on the STIHL Engine Check can be recorded
- Once repairs have been made the last part of the STIHL Engine Check document can be used as a quality control check to be sure the engine starts easily and is running to specification
- A Roll Out Test is done with the engine at idle speed and warmed up
  - Hold the engine in its normal operating position
  - Roll it over so the air filter faces up and the engine speed should not change more than 100-200 RPM
  - Roll it over so the muffler faces up and again the engine speed should not change more than 100-200 RPM
  - Continue this procedure by holding the engine in several different positions
- Any excessive change usually indicates a crankcase air leak or fuel delivery problems